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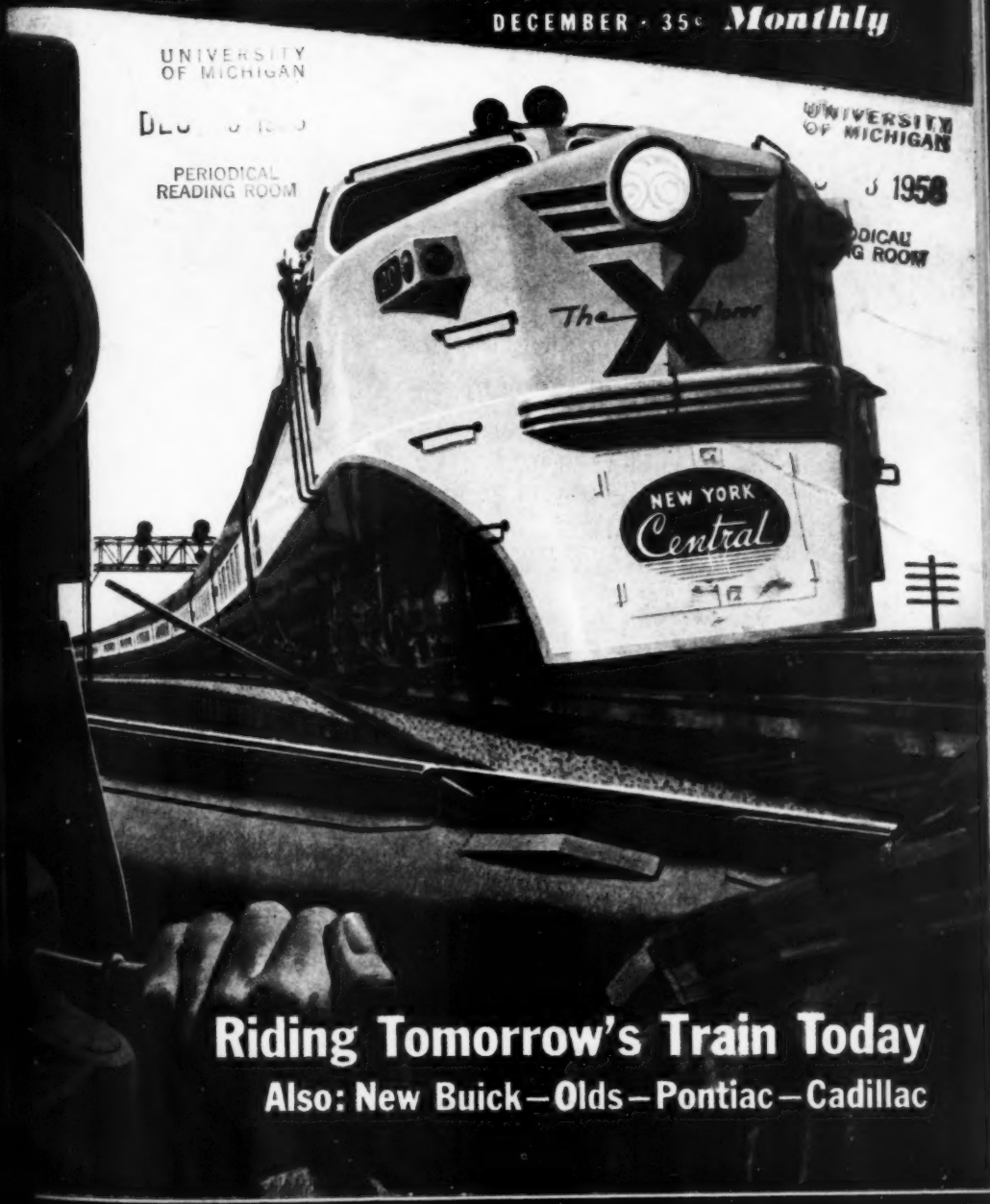

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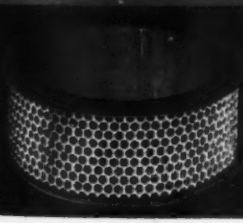

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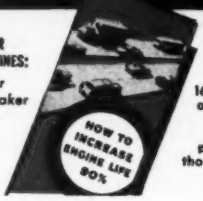

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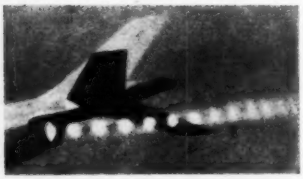
Popular Science Monthly

December, 1956

1957 Cadillac's revolutionary frame design lowers the car three inches with no loss of passenger space —and it's stronger, too.



From turbojets to TV sets . . . from the tropics to the troposphere . . . PS Picture News scans the globe to bring you spot news at a glance.

AUTOMOBILE NEWS

Science Designs a Crashproof Car · 94
X Marks the Frame in the New Caddy · 108
Buick Torque Tube Gets New Wrinkle · 111
Picture Tour of the '57 Oldsmobile · 114
How Pontiac Lost Its Stripes · 116

WORLD OF SCIENCE AND INDUSTRY

The Locomotive That Shifts Like a Car · 72
Outer Space Comes Down to Earth · 77
New Sub Points Way to Undersea Liners · 82
Scrolls Picture Christ's World · 98
How Your Electric Meter Works · 104
Invitation to Inventors · 107
German Bus Cruises Texas Highways · 118
Atomic Freighter Planned in England · 140

THE NEWS IN PICTURES

Taillight Guides New Rocket to Target · 123
Jet Leaves Fiery Trail of Shock Beads · 124
1957 Thunderbird Rolls In on 270 Hp. · 125
Engineer Lives in Iron Bubble · 126
Poor Man's Rocket Is Launched · 127
New System Records Air-Trophy Speeds · 129
Toothed Auto Wheels Bite into Snow · 132
Copter Carries Along Its Own Hangar · 135

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SPECIAL FEATURES

Inside the 1957 TV Sets · 78
What Happens If You Drink Too Much · 86
Winter's Wildest Highway Battle · 90
Gus Fixes an Eggbeater · 142
Choosing the Right Hi-Fi Tone Arm · 176

When to say when: The sober truth about the effect of alcohol on your body and brain.

FOR THE HOME MECHANIC

Installing Modern Switches and Outlets · 147
Blow that Stud Down! · 153
Easy Wood Joints Are Strong Now · 161
Barrow Mixer Delivers Concrete · 165
I Built a Snow Blower for $25 · 166
Use Three Blades for Faster Saw Jobs · 171
A Floor Polisher That You Can Make · 183
How to Control Hardboard Expansion · 185
Three Ideas for Christmas · 190
The Roof That Lets You Move Walls · 193

Now it's a snap to update your home's electrical system.

WHAT'S NEW IN . . .

Ideas from the Inventors · 119
Aids to Modern Living · 139
Handyman Products · 152
Car Accessories · 181
Shop Ideas · 188
Tools for Your Shop · 196

EVERY MONTH . . .

PS Readers Talk Back · 4
Keeping the Home Shipshape · 10
Prize Projects by PS Readers · 12
I'd Like to See Them Make · 14
PS Late News · 17
Hints from the Model Garage · 145
Wordless Workshop · 158

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PORTLAND, ORE.—520 S.W. Sixth Ave.

Published monthly at 353 Fourth Avenue, New York 10, N. Y., by Popular Science Publishing Co., Inc., Godfrey Hammond, Chairman of the Board; Ralph H. Flynn, President and Treasurer; Franklin E. Parker Jr., Secretary; Eugene Watson, Vice-President. Second-class mail privileges authorized at New York, N. Y., and Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A.

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PS Readers

TALK BACK

Love Those Volkswagens

I SUPPOSE it's never too late to compliment you on your excellent article concerning the Volkswagen trip from Chicago to New York [Sept.]. I now own my third VW,

so it is needless to say I really enjoy the little bugs.

I made an extended trip to the Middle West that included your route. I totaled the same time as you did. The only thing we don't agree on is the gas mileage, which was 29.6 for you and 36.1 for me.

THOMAS D. HESS, Agawam, Mass.

. . . The VW is capable of considerably better performance than your correspondents obtained. I recently toured—with a long-legged friend and camping equipment—2,128 miles through the Canadian Rockies. Our average for the entire trip was 34.8 miles per U.S. gallon, with some fast-driving day-long trips giving as much as 40.7.

ALLAN D. FRASER, South Burnaby, B.C., Canada

Continental's Not Bad, Either

I DROVE a 1947 Lincoln Continental [see "We Drove a Continental from Chicago to New York," Aug.] from Morrison, Ill., to Bloomfield, N. J. For the whole trip of 974 miles, average speed was 55.6 m.p.h., "in-motion" time 17 hours, 30 minutes. The V-12 engine averaged 15.3 miles per gallon of standard-grade gasoline.

Not bad for a car 10 years old which has gone nearly 200,000 miles.

ROBERT C. FORTIN, Bloomfield, N. J.

PS Boat Light Is Right

IN YOUR September issue you published an article on how to make a combination bow light for boats [p. 238]. I do not think it would be permissible to use such a light, since Coast Guard regulations specify that:

Red-and-green combination lights show red from dead ahead to two points abaft the port beam, and green from dead ahead to two points abaft the starboard beam.

The light that you described was a 32-point light [visible all around] that had been divided in half.

JOSEPH D. FELDMAN, Benton Harbor, Mich.

The illustrations with that article may have misled you. The combination light was shown with a mounting that would have made its red and green sections visible as required by regulations. Another picture did show a 32-point light installed on a boat, but this was a white stern light, which should be visible all around.

PS Outboard Hot Rod Hits 36 M.P.H.

HERE'S the result of your article "How to Build This Outboard Hot Rod" [Mar.]. I raced this speedster all summer and can truthfully say that not a single boat beat me.

I weigh 200 pounds and stand six feet one, which goes to prove that these boats

aren't for small guys only. Despite my weight, my 10-hp. Hurricane Merc delivers speeds up to 36 m.p.h.

ROBERT STELLATO, Worcester, Mass.

Color TV Story Had Right Angle

IN YOUR article, "How Color Television Works" [Oct.] you state that a vertical magnetic field moves the electron beam back and forth, and a horizontal field moves the beam up and down. According to the physics experiments I've seen, a magnet on a cathode-ray tube bends the electron beam

THE HOW AND WHY

OF THE WORLD'S PUREST SILICON

The purification of silicon by Bell Laboratories metallurgists has been richly rewarding. Their original research in this field revealed the chemical factors that control semiconductors; it was a major advance leading to Bell Laboratories' invention and development of transistors and the Bell Solar Battery. Now they have devised a simple but highly effective way to remove boron — one of the most difficult impurities to extract from silicon.

During refining, a stream of hydrogen and water vapor is kept flowing past the silicon. As the water vapor passes over the liquid silicon, it seizes boron atoms, forming boron oxide. The oxide is then pulled away to condense on the wall of the refining tube which is cooled by a water stream. Result of refining: boron and other harmful impurities are reduced to less than one part in 10,000,000,000.

The new silicon is being used to develop still better transistors and rectifiers for telephony. It is another example of how Bell Laboratories metallurgists help open the way to improved telephony.

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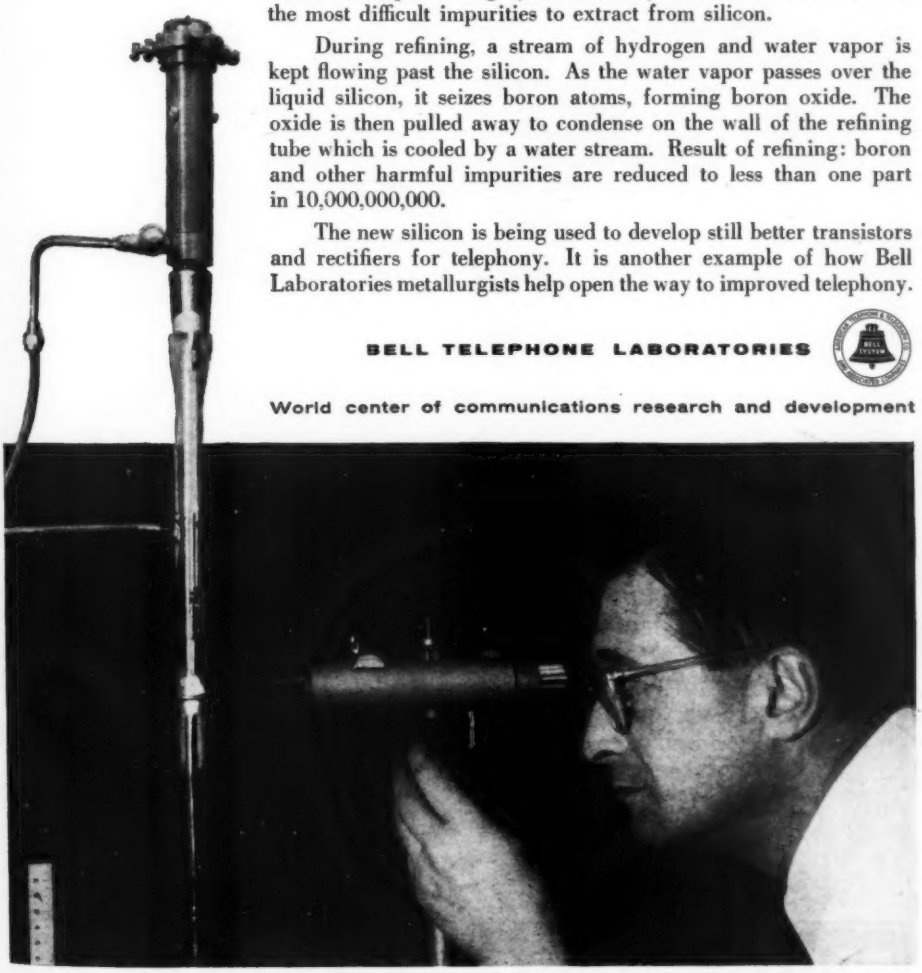

Metallurgist Henry C. Theuerer, M.A. in Chemistry, Columbia, watches a molten zone in a silicon rod under purification. Mr. Theuerer's most recent achievement was development of water-vapor treatment for removal of boron.

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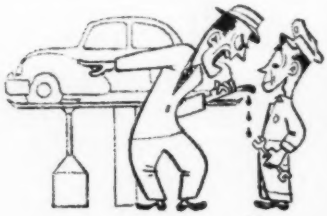
toward the magnet. The vertical magnetic field moves the beam up and down, and the horizontal field moves the beam left and right.

JAMES JOLIN, Madison, Wis.

Our article was correct. When an electric current flows through a magnetic field, the force on the current is at right angles to the direction of the magnetic field. The electron beam in a TV tube behaves like any other current. The electromagnet poles above and below the tube neck generate a vertical magnetic field surrounding the electron beam. This moves the beam horizontally, at right angles to the direction of the field. The physics experiment that Reader Jolin describes is usually performed with a permanent magnet held to one side of a cathode-ray tube, not around its neck. Depending on the position of the magnet, the electron beam may then be deflected toward the magnet's poles.

In Defense of Auto Repairmen

AFTER reading "How to Foil the Auto-Repair Crooks" [Sept.], I am forced to stand in defense of 500,000 small-business men who run service stations. I visualize thou-



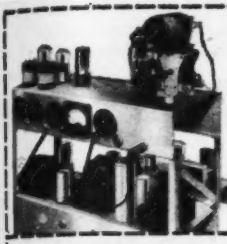
sands of readers unjustly accusing these dealers of cheating them on oil changes because of the darkened color of the recently changed oil.

Fresh oil may *look* dirty after as little as 50 miles' driving because it stirs up foreign particles that have settled out in the engine and oil lines. A gray color may also come from lead in gasoline that gets into the crankcase.

WILLIAM R. GIBSON, Chicago

. . . I am sure that there are no more, fewer, dishonest garage and service-station operators than there are dishonest TV repairmen, grocers, etc.

Operating a garage is extremely difficult in these days of complex cars. Your point about allowing enough time to do a good



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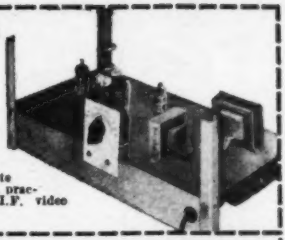
As part of N.R.I. Communications Course you build this low power Transmitter; use it to learn methods required of commercial broadcasting operators, train for FCC license.

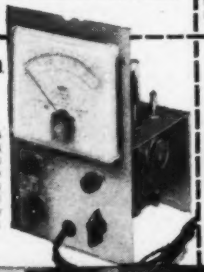
YOU BUILD Signal Generator

N.R.I. sends kits of parts to build this Signal Generator. You get practical experience, conduct tests to compensate Radio frequency amplifiers, practice aligning a typical I.F. video amplifier in TV circuit.



YOU BUILD Vacuum Tube Voltmeter

Use it to get practical experience, earn extra cash fixing neighbors' sets in spare time. With N.R.I. training you work on circuits common to both Radio and TV. Equipment you build "brings to life" things you learn in N.R.I.'s easy-to-understand lessons. 64-page Catalog FREE, shows all equipment you get.



YOU BUILD AC-DC Superhet Receiver

N.R.I. servicing training supplies all the parts, everything is yours to keep. Nothing takes the place of practical experience. You get actual servicing experience by practicing with this modern receiver; you learn-by-doing.

Learn RADIO TELEVISION

by Practicing at Home

WHAT GRADUATES DO AND SAY

"I am Chief Engineer of Station KGCU in Mandan, N.D. I also have my own spare time business servicing high frequency two-way communications systems." R. BARNETT, Bismark, N.D.

"We have an appliance store with our Radio and TV servicing, and get TV repairs. During my Army service, NRI training helped get me a top rated job." W. M. WEIDNER, Fairfax, S.D.

"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix car Radios for garages. I paid for instruments out of earning." G. F. SEAMAN, New York, New York.

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job is actually the most important part of the article.

RICHARD D. STEVENSON, Lake Bluff, Ill.

Down with Small Wheels!

THOSE new 14-inch wheels and fatter tires [Oct.] are made to order for the fuel industry. The wider and softer the tire, the harder the car is to pull and the more gas it eats. But how about us poor devils who have to buy the extra gas they'll require?

I keep my 7.60 x 15s inflated to around 32 pounds and gain about four miles per gallon. The tires last longer, too.

I'm beefing. But what can I do about it if I want a new car? Get a Volkswagen—or a horse!

CHESTER T. TAYLOR, Mitchell, S. D.

. . . The picture of the new 14-inch wheel on page 97 shows two weights of five or six ounces each on the rim. If the wheel was dynamically balanced, this means a couple more blobs of lead on the back. Why can't the tire makers spend more time making true, round, balanced tires instead of thinking up ways to keep stock on dealers' shelves?

I buy 10 to 12 tires a year and haven't been able to find any decent ones lately. They are all lopsided and need all sorts of tender loving care to make them roll at any speeds above the Model T range.

GORDON E. WALLACE, Anniston, Ala.

Which Way Is Up?

WOULD PSM settle an argument? If a helium-filled balloon is tied to the floor of a car so that it floats unobstructed, and all windows are closed so that the outside air stream cannot influence it, which way will the balloon move when the car is gunned? And which way when the brakes are slammed on?

WALTER L. HAROLD, White Plains, N. Y.

A lighter-than-air balloon rises because the heavier air sinks under it, displacing it upward, just as water floats a cork. Acceleration of the car temporarily makes the rear window "down" to everything inside the car, so the air will "sink" around and behind the balloon, pushing it forward *as the car speeds up. Braking would make the balloon move to the rear.*

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. . . even if now employed

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These are full time dealerships . . . but you can start in spare time and have a profitable, lifetime business when your present job ends. A Duraclean dealer will train and assist you. He'll reveal his successful, proven methods and sales plans. He'll **work with you.**

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Demonstrations win new customers. DURACLEAN Dealers find REPEAT and VOLUNTARY orders a major source of income. Customers, enthused with results, tell friends and neighbors. Furniture and department stores and others turn over rug and upholstery cleaning and mothproofing to **DURACLEAN** Dealers. We show you **27 ways** to get new customers.

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Gerald Merriman: $700 cleaning...only 13 working days.
P. D. Freidinger: 70% of our business is repeat.
A. Ullman; Every demonstration has been a sale.
Ellsworth: Your advertising certainly has paid dividends.
M. Lassanske: Original investment returned in two months. Not sorry I started 'on a shoe string.'
B. Kimbrough: Finished First White House of Confederacy and am to **Duraclean** the Governor's Mansion.
Margarette Turner: Took in $106 in 15 or 18 hours.
L. Johnson: Each customer leads to 3 or 4 more.

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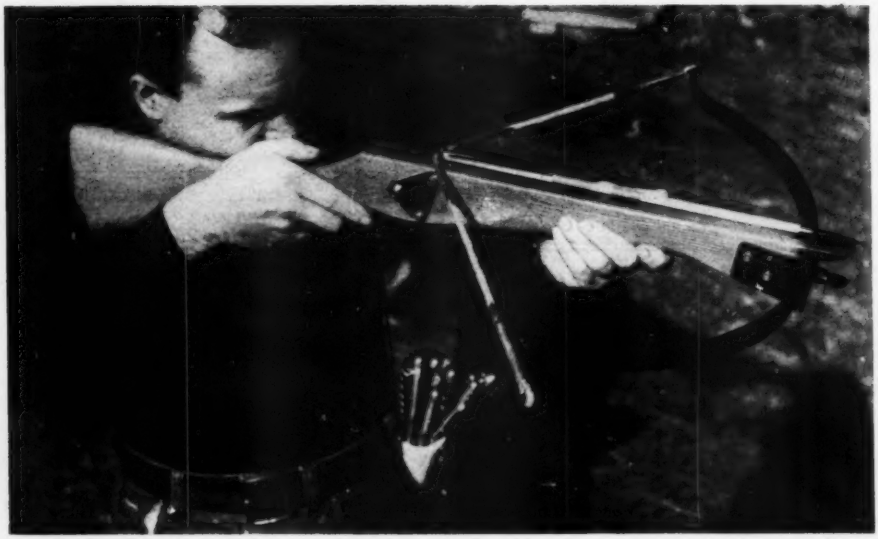
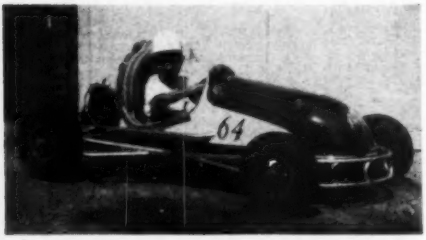
Prize Projects BY PS READERS



Bow Made from Car Spring. E. R. McCafferty of Naches, Wash., went to the auto junky for the bow of this lethal weapon. Ground from a spring leaf and strung with twisted strands of shoemaker's linen thread, it takes a 150-pound pull to draw it. A stirrup (not shown) fits into the eye at the front of the crossbow and the archer stands on this to anchor the stock as he yanks the drawstring.



Hot Rod for a Six-Year-Old. Reading about Dad-built midgets (PS, Apr. '55) lured Waldemar Janke of Westbury, N. Y., into a six-week sweat turning out this winner. Mostly waterpipe and electrical conduit, it is topped off with an aluminum body. The 1½-hp. engine drives through three gear ratios, but Pop favors 8-to-1 for tough competition. Junior has rolled in for two wins so far.

Washer Spins Clothes. Built by Lloyd M. Frazier of Corvallis, Ore., this pint-size version of an automatic washer doesn't hold water but has a tiny agitator that oscillates and beats a doll's clothes with plywood fins. Like the tub, the body of the agitator was turned from wood. The drive rod works off a universal arm that leads to a hand crank at the back of the midget washer.

Have *you* recently completed a workshop project of which you are particularly proud? Send a good photograph of your work, along with the negative and a brief description, to POPULAR SCIENCE MONTHLY's Mechanics and Handicraft Editor, 353 Fourth Ave., New York 10, N. Y. We will pay $15 for each item that is accepted for publication.

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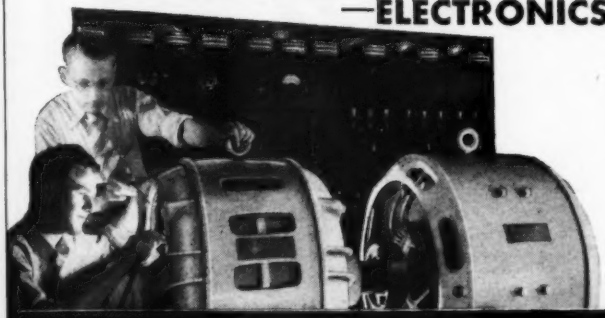

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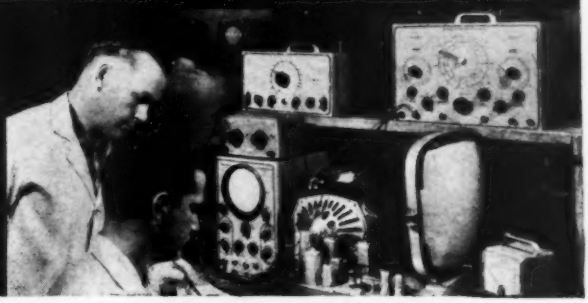
(Right — Instructor helping students check the wiring and trace circuits of television receivers.)



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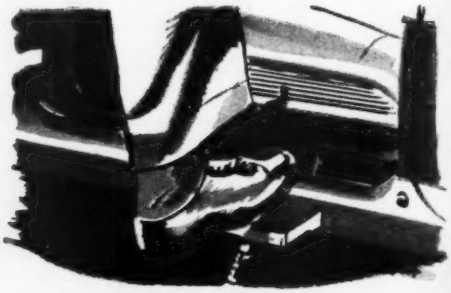
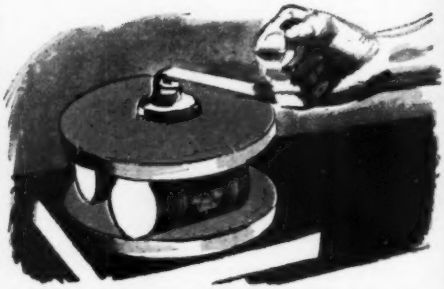
"I'd like to see them make..."

HALF-ROUND ARTIFICIAL CHRISTMAS TREES. If one side rested flat against the wall, a tall tree with wide-spreading branches wouldn't crowd a room.—*F. M. Scott, Jersey City, N. J.*

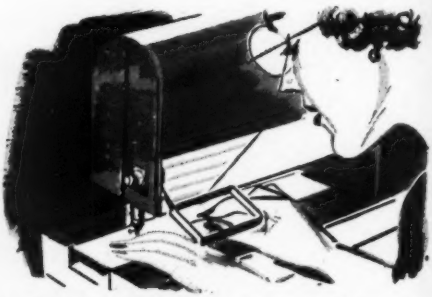


A SHOE SCRAPER AND BRUSH on cars. It would pull out from beneath the chassis to remove snow or mud from your shoes before you stepped inside.—*Wm. B. Reeves, Millville, N. J.*



A TIN-CAN PRESS to flatten space-wasting empties. A heavy disk riding on a screw turned by a handle could mash cans laid on a base plate. —*Mrs. E. Miller, Lansing, Mich.*

MAGNETIC INSERTS IN POT HANDLES so that a steel stirring spoon could be laid along the handle where it would stay fairly cool and be handy for use.—*R. R. Prelletz, Chicago.*



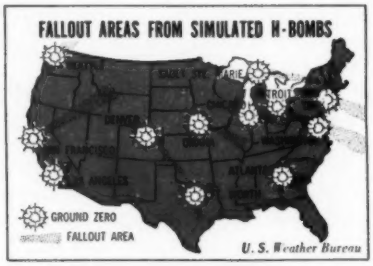
A NEEDLE MAGNIFIER on sewing machines. A swivel mounting would let you swing it down to thread the needle then flip it up out of the way.—*Mrs. D. Robinson, Greenfield, Ohio.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE MONTHLY readers. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

PS Late News

Will we see over the edge of the universe? This intriguing possibility is raised by new electronic devices that amplify light to multiply the reach of astronomers' telescopes. Westinghouse showed off one of the latest, a compact attachment intended for the Palomar telescopes. It works like a television camera, displaying on a luminous screen an image 10 times brighter than the telescope could otherwise produce. This lets the telescope detect fainter stars, increasing its range nearly three times—Palomar's big 200-inch job could then see perhaps six billion light years away. There might not be anything that far off. The universe began, most scientists believe, as a point that exploded five or six billion years ago and has been flying apart ever since. The parts—stars—would not have had time to get so far away from us that their light would take six billion years to reach us. If the amplifier-equipped telescopes do pick up objects at such a distance, the astronomers may conclude that they are: (a) wrong about the origin of the universe, (b) seeing other universes now unknown, or (c) watching Genesis.

Weather makes a big difference in an H-bomb attack, as this map shows. The shaded areas indicate how far radioactive fallout would have spread 12 hours after bombs hit these cities, based on the wind patterns for last September 10. Strong northwesterly winds aloft in the eastern part of the United States would carry bomb debris from Detroit to the Washington area within half a day, says the Weather Bureau.



The Government's campaign against bootleggers of stay-awake pills—see "Don't Stay Awake to Die," PS, Oct.—scored 100 percent. The Food and Drug Administration told POPULAR SCIENCE this fall, "Pleas were entered in all cases, and all the defendants have been sentenced, except one." Meanwhile one physician, Dr. John R. Rodger, spoke out to defend the stay-awake drug, amphetamine, as a means of keeping drivers alert. It is a valuable accident-preventive, he said, when properly prescribed for people who must drive when tired or who get sleepy at the wheel even when they are not tired.

The controversy over polio vaccine that upset parents last year threatens to flare up again. Now there's a new vaccine ready for testing (not general use). This one was developed by Dr. Albert B. Sabin, a

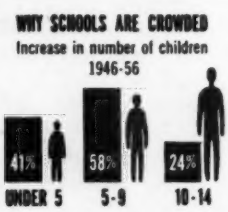
Late News

vocal critic of the Salk vaccine. Sabin uses *live* polio virus of a breed that cannot cause illness but can induce immunity to the harmful polio virus.

New kinds of color-television sets—possibly cheaper—may be on the market in a year or so. The big change will be in the picture tube. All color sets now use three-gun tubes, with one electron gun for each primary color. These are delicate and costly to make. A single-gun tube would be simpler. Du Mont is now getting one of this type—the Chromatic, invented by physicist Dr. E. O. Lawrence—ready for mass production. General Electric and Philco are also working on one-gun tubes, but have said nothing yet about production.

A machine that reads out loud to blind people seems close to actuality. There have been "light pencils," which read ordinary printed letters and convert them into electrical signals. The problem is converting the electrical signals into recognizable sounds. Most machines either give out beeps or monotonously spell words letter-by-letter. Now Dr. Milton F. Metfessel of the University of Southern California has invented a new machine language, called "spelled-speech." It is an easy-to-learn pidgin English that uses 25 sounds to represent the 26 letters. These sounds are recorded on a magnetic drum. A scanner recognizes the printed letters, and signals the drum for the equivalent sounds. The sounds are played off the drum in rapid succession, making audible words in spelled-speech about as fast as people ordinarily talk.

What every taxpayer knows, as well as every parent and school official, is only pinned down in the cold statistics at the left: There are more children than ever before. The population 18 years old and younger is now nearly 56,000,000, an increase of one third—14,000,000—over the figure 10 years ago. (By comparison, the number of children increased only 12,000,000 in the 30 years between 1900 and 1930.) The big bulge is in the five-to-nine-year-old group; the number of youngsters in the 15- to 17-year-old bracket has actually decreased.



Metropolitan Life Insurance Co.

Short takes. Redecorating your house will cost more this spring. The big paint manufacturers are raising prices, 25 to 30 cents a gallon . . . Motorists like the new super-high-test gasoline (see PS, Oct.). Sales match the gas companies' expectations, and Sun Oil is expanding use of its five-in-one pump (a dial selects the grade you want) throughout Florida and into Georgia . . . Tires made of butyl, the synthetic used for inner tubes, will be on sale experimentally. They hold air better, stop shorter, won't squeal, resist oxidation. Price: About $100 per set.

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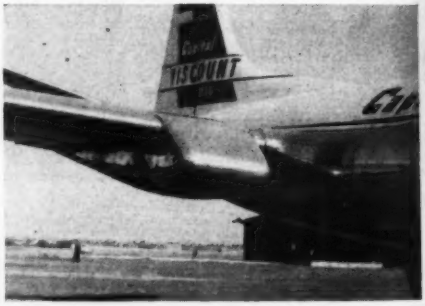

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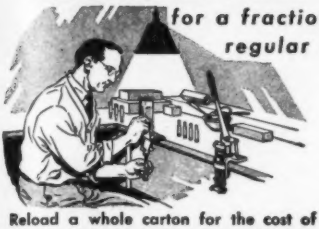

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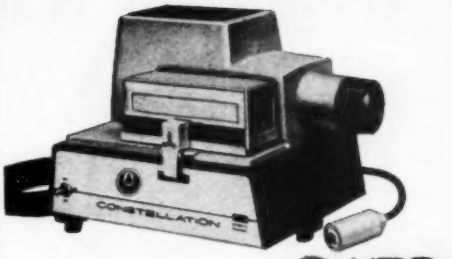

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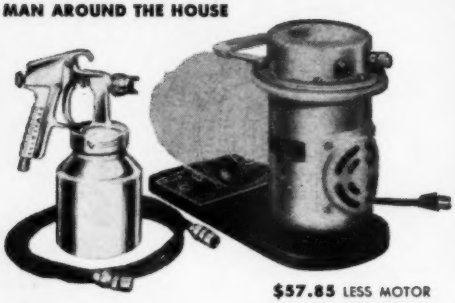

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- Delivers clean, oil-free air — pressure adjustable
- Ball-type main bearings — shielded, permanently lubricated

This powerful "Tuffy" Outfit atomizes even heavy-body paints; sprays with a full wide pattern. Operates hour after hour under load without fatigue, and provides maximum pressure with minimum pulsation and vibration.

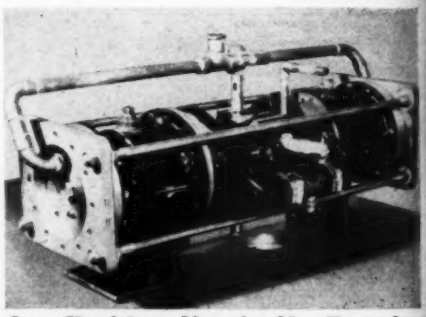
THE DeVILBISS COMPANY
Toledo 1, Ohio

Santa Clara, Calif.
Barrie, Ontario
London, England
Branch Offices in Principal Cities

DeVILBISS

Bag Machine Wraps Garments

DRY cleaners now have this automatic bag maker that will wrap up their work in bags to fit garments' varying lengths. A plastic tube fed through the rollers is pulled down over the garment, then buttons are pushed to heat-seal the top of the bag and free it from the roll. The Mehl Co., Cincinnati, makes the machine.



Car Turbine Needs No Repairs

SOME day your car may have an engine without a crankshaft and spark plugs—like this experimental free-piston turbine that burns diesel oil or low-octane fuel. It's so durable, Ford says, it may ultimately be marketed as a sealed package. Major problems yet are noise and simplifying engine speed controls.

REVOLUTIONARY NEW OUTBOARDS!

2. New 10 h.p. Mercury for super-slow trolling!

• The new Mercury Trol-Twin was designed expressly for fishermen! New glide-angle underwater structure slides smoothly over stumps, rocks and through thickest weeds, puts cylinders at their best idling angle for hours of slow trolling. Single lever control . . . throttle, neutral and reverse all on one-hand control. Big displacement for power to plane your boat . . . get fishing fast.

Prop-Jet Exhaust buries exhaust under water and with it the sound. Ask your Mercury dealer about his new easy terms today! You'll be glad you did.

FINGER-TIP TROLLING. *Just flick the exclusive Speed-r-Troll Switch! No ordinary throttle can give you idling speeds as low as this . . . or so steady!*

ONE-HAND CONTROL! *Twist the tiller handle for speed. Twist again for neutral or reverse. One control does everything.*

EXHAUSTS THRU PROPELLER HUB! *Exclusive Mercury Prop-Jet Exhaust buries exhaust under water . . . leaves it far behind.*

Write today for complete color catalog

KIEKHAEFER CORPORATION • *Fond du Lac, Wisc.*

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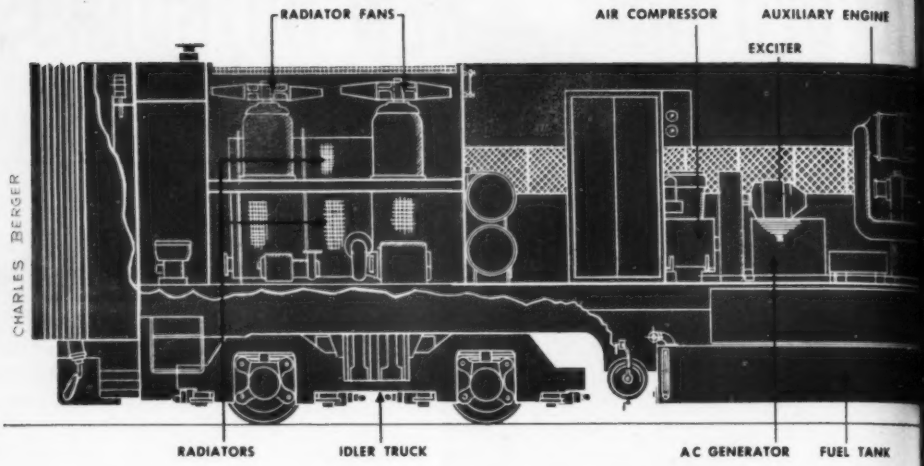
12 NEW MODELS » 6 to 60 HORSEPOWER



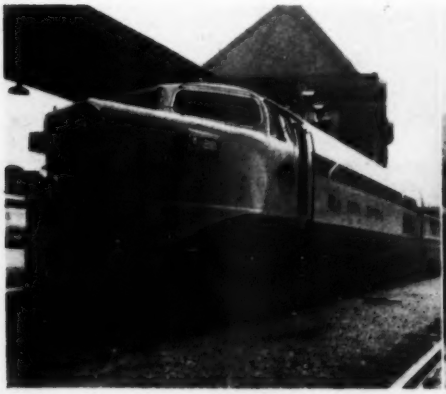
Riding the Locomotive

What it's like in the cab of the first diesel mainliner to

WITH airlines stealing away much of their Pullman business, railroads are making a big play for short- and medium-haul coach riders. The bait—and it's a mighty good one—is in the form of fast new trains.

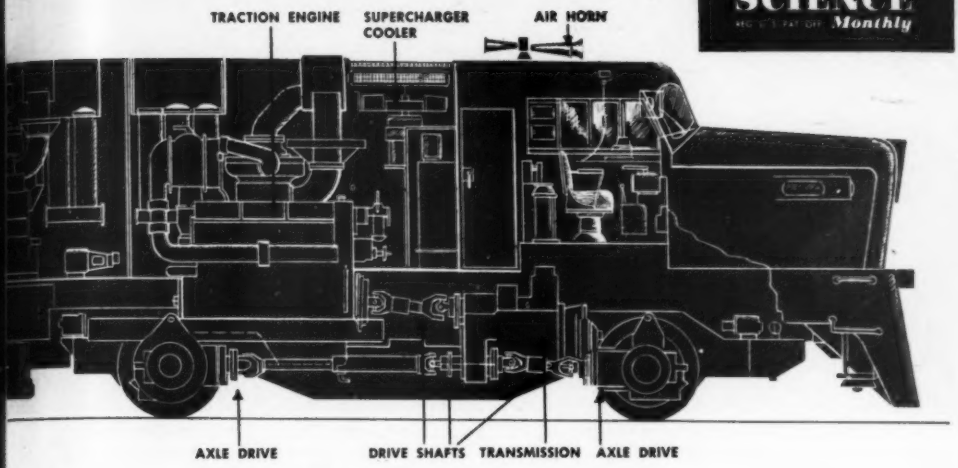
Most revolutionary of these is the New York Central's Xplorer, headed by a brand-new locomotive. This 120-m.p.h. diesel has a four-speed torque-converter transmission that's big brother to the one in your car. To see it work, come ride the cab from Cleveland to Cincinnati.

You enter the locomotive from the head coach, pass the big dual-fan radiator, and squeeze by the 570-hp. auxiliary engine, which supplies com-



Xplorer's engine is a diesel-hydraulic unit. One to run on the New Haven will have electric motors besides, for tunnel use.

Fireman's-eye view shows the auto-like cowl of the new locomotive. Its cab is almost directly over the front wheels.



That Shifts Like a Car

have a torque-converter transmission **By Harry Walton**

pressed air and electricity to the entire train. The air smells of hot oil. Around you is the rolling thunder of two diesels.

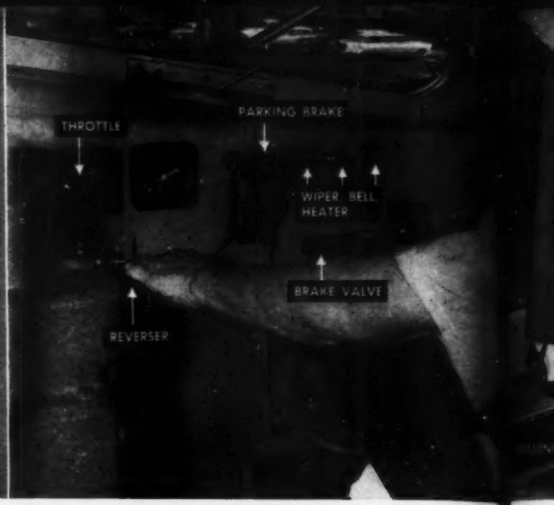
With the bulkhead door shut, speech is possible in the cab, a space 10 feet wide but only half that deep. It has that look of steely austerity you expect in a locomotive. But the enginemen's seats are comfortably upholstered, and the side windows have sliding panels and wind wings.

For riders there is a wooden bench with a cushion, set against the bulkhead. Tucked into a niche is a water cooler. Beside it is the instrument panel for the 1,000-horse traction engine. The tachometer quivers at 600 revs,

The Xplorer noses onto a truss bridge. Cleveland-Cincinnati run pits the new train against auto, bus and airline competition.

Bob Cooper, a veteran engineer with 41 years of railroad service, highballs the Xplorer on its start out of Cleveland.

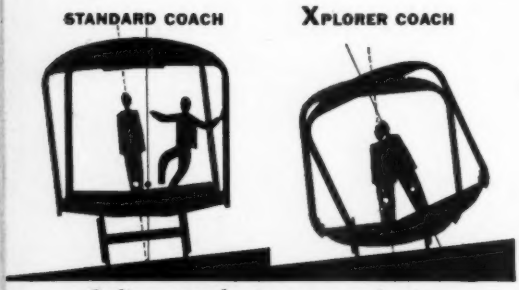
James Dougherty checks traction-engine gauges. Starting instructions are taped above. A 64-volt battery powers starters.



Engineer needn't think about gear ratios. They're chosen for him by governors on driving and driven sides of transmission.

the idling speed of this 12-cylinder power plant. A beep signals departure time. Engineer Bob Cooper releases brakes, slaps the reverser forward, and pulls the throttle to the first slot.

A red bull's-eye on the control stand warns Cooper that the transmission has not yet shifted to forward low. This he has to watch; unless it does so in 10 seconds, the engine shuts down automatically. But almost at once the red winks out, the engine revs up to 1,000, and the train slides out of Cleveland terminal.



Ordinary coaches sway out on fast turns. The Xplorer's bank right into them. You can stand or walk with less lurching.

Cooper opens the throttle farther. The engine threads its way through a spiderweb of tracks. Dimly seen in the morning mist is the highway bridge over the Cuyahoga.

"Now watch," says Cooper. "The transmission will upshift at 26."

As the big speedometer edges up, there is a brief toe-stubbing sensation, a hiss from the control stand, and you roll again. You felt something like it with the early automatic car transmissions.

"It'll shift to third at 44, and into high at 70," the engineer explains.

Now the throttle is in the sixth notch, the tach at 1,500. You wait for the upshift at 44; it's quicker than the first.

Fat raindrops spatter the windshield. Fireman Don Thornton, a good-looking young fellow who wears his cap visor straight up, pulls a button to start his wiper. His Spartan dashboard has only wiper, engine bell and cab-heater buttons, plus a king-sized glove compartment stuffed with clean rags. Behind him is the hand brake.

Sleek and low, coaches are fitted with folding steps. It's only two steps down to a low-level station platform like this.

Wheel axles are pivoted so that they automatically steer around curves, enabling cars to hug the rails at high speeds.

Rough track starts the engine lurching. Wheels triphammer over switch points, but with clear track ahead the speedometer inches up, past 60 and then 65. Cooper sounds the air horn for a crossing. You're past it at 70 (the upshift into fourth is hardly noticeable) and speed is still climbing. The train leans smoothly into a long curve at 75.

"Double yellow," Thornton calls out, almost before you can spot the signal.

Throttle back to idle, the engine loses speed. At 70 it downshifts to third.

Further signals make Cooper apply the brakes. An acrid whiff as of brake lining sweeps into the cab; the shoes are composition instead of cast iron. At Boyd tower a man stands beside a yellow signal. The train is still rolling as Cooper scoops up a train order.

The green flimsy annuls a previous order. "They've got the westward track repaired," says Cooper. "Saves us waiting for that manifest freight."

Refreshments are sold from a cart that goes from coach to coach. But demand is for fuller meal service.

The other train roars past before you're under way again. Cooper blasts a greeting as you glide by a section gang.

You've noticed that the air-brake lever isn't seesawed back and forth as usual. It's simply moved as far right as necessary to give the desired braking.

The cab lever energizes magnetic valves in each car, which shoot air from car reservoirs to brake cylinders. With electricity flashing the word back, brakes go on at the last coach the same instant as at the first. There's no train-line lag.

"I sure do like this new brake valve," says Cooper, whose opinion has

When you ride the train of tomorrow, you'll find . . .

- Fares are the same as in ordinary coaches, but the ride is different—smoother, more comfortable. All the bounce is in the locomotive; the cars glide.
- There are no Pullman berths, and you cannot buy reserved seats. Seats recline to let you doze comfortably.
- Baggage cannot be checked through. But luggage racks are lower than usual for easier loading.
- Rest rooms show they've been planned, not crammed in as an afterthought. They're bright and roomy. The hot water is hot.
- There is no diner. A lounge car and a traveling cart provide light refreshments, hot-platter meals.
- Windows have no shades to struggle with. Instead, the glass is deeply tinted at the top, less so lower down.
- It's quiet. Sealed windows, soft head-lining materials, acoustic baffles and rubber mountings insulate you from track noises. You can hear whispered conversations.
- Cars are colorful, with plastic walls bonded to plywood. The floor is vinyl-surfaced tile.
- It's easier to stand or walk. Coaches lean into curves instead of away from them. You sit in your seat without sliding.
- Radiant-panel heating and air conditioning provide comfortable temperatures in any weather.

41 years of railroad service behind it.

At Crestline a "bottom yellow"—with two reds over it—cuts speed to 20. Between 20 and 30 the engine has a rough waddling gait; on poor track, it rolls like a drunken duck.

In the Galion yards signals call for a full stop. "Got to take the running lead," Thornton says. "Number 11 must be in trouble."

The full engine roar bursts upon the cab as the bulkhead door is opened by a preoccupied young man with a shock of dark hair. He's James Dougherty, a design engineer for Baldwin-Lima-Hamilton, makers of the locomotive. Opening a hatch in the forward bulkhead, he crawls into the shark nose to check control equipment. He emerges to stay in the cab as you pick up speed on the running lead. Passing No. 11, Cooper gestures and watches the crew signal back.

"Flat wheel," he says. "They've got to set out the baggage car."

With clear signals, Cooper holds to the 79-mile limit, slowing down only for a 60-mile curve. Rain sleets down hard, almost obliterating the track despite the frantic sweep of wipers. Louder than the storm, the air horn wails warning.

Spray flies in the windows, but it's your ankles that get wet. A four-inch fountain is spouting up from the floor. Thornton grins, helps move your bench.

Dougherty throws back two hinged floor boards. The jouncing bulk of the transmission gleams wetly beneath, a whirling drive shaft behind it. Wheel rumble is loud as he lines the floor flanges with strips of rag. When he drops the boards back, the fountain is licked. It's one of the little things designers can't foresee on a blueprint.

But the rain has let up when Cooper pinches speed down to 45 near Columbus. Picking up the train order and running around No. 11 has cost 10 minutes.

At Columbus a new crew takes over. Engineer Ralph Eisnangle, a square-jawed, keen-eyed man who could play the role in a Hollywood rail epic, makes up two minutes on the single track to Cold Springs.

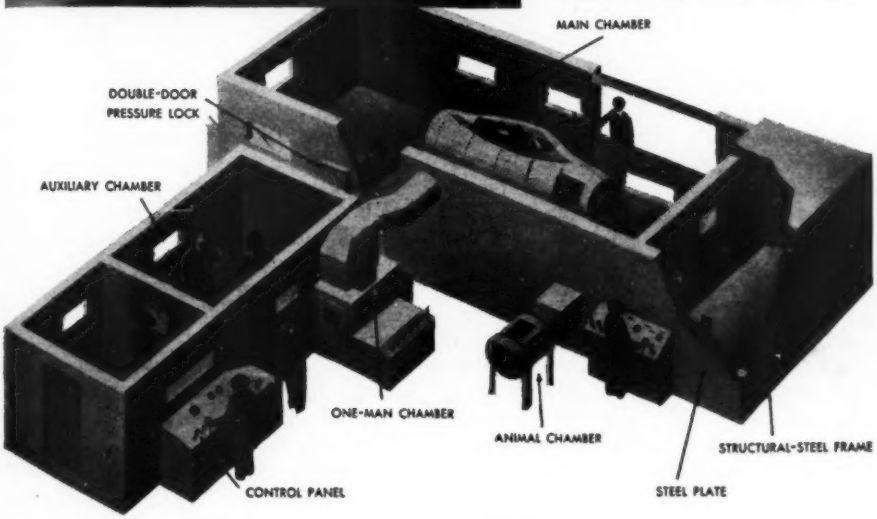
But the signals turn yellow again before Dayton. At low speed, the engine

[*Continued on page 230*]

Coming next month: Santa Fe's Two-Story Train

Outer Space Comes Down to Earth

COMPACT ARRANGEMENT of the Air Force's new 46-ton space apartment is shown in cutaway below.



INSIDE the room at the top of the page you could "fly" 150,000 feet up and feel what it would be like to blow a canopy in an emergency bail-out at that altitude. You would be wearing a pressure suit and breathe through an oxygen mask, of course, but if anything went wrong, there's that man outside ready to come to your rescue.

It's one of six rooms in the new space lab at Wright Air Development Center near Dayton, Ohio. Animals and humans can also be tested under conditions simulating the explosive decompression that would take place if a moon-bound rocket ship were punctured by a meteor.

COCKPIT of a salvaged F-86 Sabrejet is installed in the main chamber. The canopy slides back when pilot ejection is simulated.

Better circuits, made by machine, give you more for your money in new television receivers. Here's what to look for when you choose your set.

Inside the 1957 TV Sets

By Hubert Luckett and Martin Mann

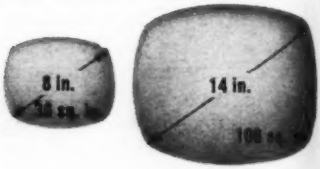
THE four-door sedan of television is the black-and-white 21-incher. It is the set most people buy. But this year its popularity faces a two-way challenge. Will you trade up to the exciting luxury of color, now cheap enough to be within reach? Or will you save money with one of the pretty little portables?

The new "standard" sets are ready for their strong competition. Most of them will cost you a *little* more than equivalent models did last year—the price rise runs around $10—but improved circuits, electronic refinements and greater use of automatic manufacturing make them, as a class, the most television for the money. Some, however, offer more than others. Here's how they stack up. The specification list on pages 80-81 gives data from 25 manufacturers on 87 basic chassis used in portable and standard receivers. These chassis are installed in many different models covering wide (and overlapping) price ranges, but it's the chassis that makes the picture. Your best buy, if you are mainly interested in a good picture, is the lowest-priced table model that uses the top-line chassis. Almost all makers put their best chassis in at least one model with a small speaker and an inexpensive cabinet. Color receivers are not listed.

Convenience. Following the trend in cars, TVs are becoming simpler and simpler to operate. You hardly ever have to touch anything besides the channel selector. Volume, brightness, contrast and clarity remain the same as you switch from station to station. More stable circuits have made this possible and have led designers to hide or leave off little-used fiddley controls. Every set still has hold and height controls someplace, but the width control is disappearing rapidly, particularly from cheaper models. All makers apparently believe that a vertical-linearity adjustment is still necessary, but all except Du Mont, Fleetwood and Tech-Master feel they can get by without a horizontal-linearity control.

You can get some kind of "lazy man's" control on nearly all sets now. Just pushing a button automatically and accurately tunes the receiver from one channel to the next. The button may be on the set itself or separate, on a small remote-

How Big Is a TV Screen?



PICTURE-TUBE SIZES are specified by diagonal measurement, corner to corner. What you look at, though, is an area, and the figures above

control box. Du Mont's remote control has a dial, like a telephone. Motorola and Zenith eliminate the wire connecting remote control and receiver, Motorola with a hand-size wireless transmitter and Zenith with a tricky ultrasonic tuning fork (PS, Sept., p. 158). Fundamentally, however, all remote-control systems work the same way: They trigger a small electric motor that mechanically tunes the channel selector.

Ease of repair. Convenience for the serviceman is getting increasing attention, too. This is important to you, since an average TV set, one survey showed, requires five service calls a year. The faster the serviceman finds the trouble, the less he charges you.

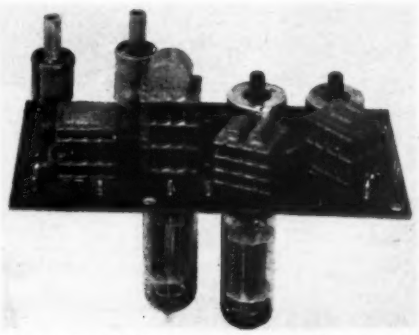
In some sets, the chassis can be removed without pulling the big, heavy picture tube. Setchell-Carlson makes repairs particularly easy by dividing its chassis into separate plug-in subassemblies. If one goes bad, the serviceman replaces it. Printed-circuit boards, now more common, offer similar convenience but may require delicate repair.

What you want. A good TV should get all the stations in your area. But beyond that, it should produce a bright, sharp and steady picture for each station. There should be no jiggles or patterns, and no "noise" (snow).

Sensitivity. If you live in a big city, nearly any set will pick up all the city's stations. But if you live in the country, or want to see programs broadcast from a neighboring city, you'll probably need a set sensitive enough for weak signals.

We asked each manufacturer to specify the weakest signals his receivers could convert into decent pictures. These figures are approximate. And many manufacturers refuse to quote figures at all, since methods of measurement vary.

This year a few receivers gain sensitivity from a new kind of tuner, the neutrode. The tuner is the business behind



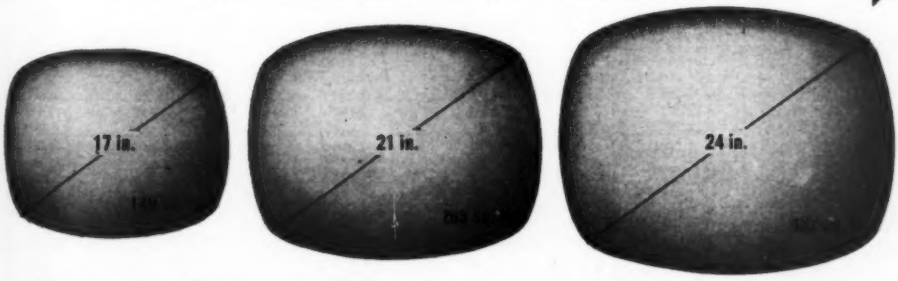
NOW IT'S MODULES—resistors, condensers and inductors machine-assembled into "stacks." Emerson is first to use them, in an oscillator-sweep section (above) for some of its De Luxe sets.

the channel-selector knob, the group of circuits that picks out of the air the particular station you want. There have been two types: the cascode, which is very sensitive to weak signals; and the pentode, which is cheaper to make.

The neutrode is almost as sensitive as a cascode yet costs about as much as a pentode. It uses printed circuits and two

[*Continued on page 222*]

On the following pages: PS chart shows how sets compare



demonstrate the big difference in effective picture size made by a slight increase in diagonal. Not all tubes of the same diagonal size deliver the same visible area (because the cabinet masks part of the picture), but the variation is never more than a few square inches.

1957 TV SPECS

	CHASSIS	CABINET DIMENSIONS AND WEIGHT (PORTABLES) HEIGHT X WIDTH X DEPTH	LB.	PICTURE TUBE FACE	FOCUS	HIGH VOLTAGE	WIDTH CONTROL	PICTURE DETAIL NUMBER IF STAGES	IF BANDWIDTH (megacycles)
	21" Super 200			gray	ES*	17,000	no	3	3.0
	21" Deluxe 300			alum.	ES	17,000	no	3	3.6
	21" Imperial 400			alum.	ES	17,000	no	3	3.6
	10" Portable	8-7/16"x10-11/16"x13-11/16"	16½	gray	ES	9,000	no	2	3.0
	14" Portable	11-1/2"x14"x15-1/2"	26	alum.	ES	9,000	no	2	3.0
	17" Portable	13-1/16"x16-5/16"x18-5/16"	32	alum.	ES	17,000	no	2	3.0
	21" VP21			alum.	ES	15,500	yes	3	3.5
	21" Advance			alum.	ES	14,500	no	3	3.3
	21" Deluxe			alum.	ES	14,500	no	3	3.3
	21" Custom			alum.	ES	14,500	no	3	3.3
	14" Portable	12-1/8"x14"x16"	28	gray	ES	10,500	no	2	3.0
	21" RA380			alum.	ES	14,250	yes	3	4.0
	21" RA356			alum.	ES	14,500	yes	3	4.0
	21" RA370			alum.	ES	16,000	yes	3	4.0
	14" Portable	12-3/8"x14-3/4"x16"	29	alum.	ES	14,250	yes	3	4.0
	21" Deluxe			alum.	ES	14,500	yes	3	3.1
	21" Eldorado			alum.	ES	17,000	yes	3	3.75
	8½" Portable	7-1/2"x11-3/4"x11-5/8"	23	gray	ES	6,000	no	2	3.0
	14" Portable	11-1/4"x13-3/4"x14-3/4"	26½	alum.	ES	12,000	yes	2	3.0
	17" Portable	13"x16-1/8"x17-3/8"	33	alum.	ES	12,000	yes	2	3.0
	21" 610			sold sep.	magn.	18,000	yes	4	4.0
	21" 810			sold sep.	magn.	18,000	yes	4	4.0
	21" 800			sold sep.	magn.	18,000	yes	4	4.0
	21" U Series			alum.	ES	18,000	yes	3	3.25
	9" Portable	9-5/16"x9-3/4"x14-3/8"	13	alum.	ES	5,500	no	2	2.9
	14" Portable	10-1/4"x13-3/8"x16"	26	alum.	ES	8,200	no	2	3.25
	17" Portable	14"x16-1/2"x17-7/8"	32	alum.	ES	13,500	no	3	3.25
	21" 2007			alum.	ES	13,000	no	2	3.0
	21" 2002			alum.	ES	13,000	no	3	3.2
	10" Portable	8-3/4"x11"x13"	20	gray	ES	9,000	no	2	3.0
	14" Portable	11-3/4"x14"x14-1/2"	30	gray	ES	11,000	no	2	3.0
	17" Portable	14"x18"x15-1/2"	36	gray	ES	12,000	no	2	3.0
	21" 323			alum.	ES	17,500	yes	3	3.5
	21" 324			alum.	ES	18,500	yes	3	3.5
	21" 420c			alum.	magn.	19,500	yes	3	3.6
	14" Portable	10-5/8"x13-11/16"x15-1/4"	26	alum.	ES	n.s.	n.s.	2	2.2
	21" U Series			alum.	ES	n.s.	no	3	3.25
	17" Portable	14"x16-1/2"x17-7/8"	32	alum.	ES	n.s.	no	3	3.25
	21" 18 Series			alum.	ES	16,000	yes	3	3.0
	21" 21 Series			alum.	ES	16,000	yes	3	3.0
	21" 117 Series			alum.	ES	16,000	yes	3	3.5
	14" Portable	11"x13-5/8"x15-1/4"	24	alum.	ES	n.s.	no	2	3.0
	17" Portable	12-3/4"x15-7/8"x16-1/2"	32	alum.	ES	14,000	no	2	3.0
	21" T19			gray	ES	14,000	yes	3	2.8
	21" TC26			alum.	ES	17,000	yes	4	3.2
	21" 69 Standard			alum.	ES	16,000	no	2	3.3
	21" 62 Deluxe			alum.	ES	16,000	no	3	3.35
	21" 63 Supreme			alum.	ES	16,000	yes	3	3.35
	17" Portable	13"x16"x15"	38½	gray	ES	14,000	no	2	3.1
	21" TS 537			alum.	ES	17,000	yes	3	3.5
	21" TS 538			alum.	ES	18,000	yes	3	3.5
	21" TS 539			alum.	ES	18,000	yes	3	3.5
	14" Portable	11-3/8"x13-3/4"x16-1/4"	26	alum.	ES	12,000	no	2	3.4
	21" 721TS			gray	ES	12,500	no	2	3.25
	21" DA			gray	ES	16,000	no	2	2.5
	21" DB			gray	ES	16,000	no	2	2.5
	21" DD			gray	magn.	18,000	yes	3	3.25
	17" Portable	14-1/8"x17-3/4"x15-3/4"	43	gray	ES	15,000	no	2	2.5
	21" V81			alum.	ES	16,000	no	3	3.0
	21" 88S2			alum.	ES	18,000	no	3	3.2
	21" 98D2			alum.	ES	19,000	no	3	3.4
	21" 7L40			alum.	ES	16,000	yes	3	3.25
	21" 7L70			alum.	magn.	18,500	yes	3	3.25
	14" Portable	10-15/16"x13-5/8"x15-7/8"	26-3/10	gray	ES	10,000	no	3	2.75
	17" Portable	13-1/2"x16-1/2"x17-3/4"	32-7/10	alum.	ES	14,250	yes	3	2.75
	21" Super			alum.	ES	15,000	yes	3	3.2
	21" Deluxe			alum.	magn.	17,300	yes	3	3.2
	8" Portable	8"x9-1/2"x13"	22	alum.	ES	7,000	yes	2	2.1
	14" Portable	13-1/4"x14-1/4"x16"	30	alum.	ES	11,400	yes	2	2.8
	21" 7110 Metropolitan			alum.	ES	13,500	yes	2	2.8
	21" 7114 Suburbanite			alum.	ES	14,000	yes	3	3.0
	21" 7132 Medalist			alum.	ES	18,000	yes	3	3.0
	17" Portable 7100	13-7/8"x15-7/8"x15-5/8"	44	alum.	ES	13,500	yes	2	2.8
	17" Portable 7102	13-7/8"x15-7/8"x15-5/8"	34	alum.	ES	13,500	yes	2	2.8
	21" C201			alum.	ES	15,000	yes	3	3.75
	17" Portable	13"x16-5/16"x16-1/2"	39⅞	alum.	ES	14,000	yes	3	3.75
	21" 32			alum.	ES	17,500	yes	3	3.4
	21" 33			alum.	ES	17,500	yes	4	3.9
	14" Portable	11"x17"x14-1/4"	26	gray	ES	12,500	no	2	2.2
	21" 5618			sold sep.			yes	3	3.5
	21" 2340N			sold sep.			yes	4	3.9
	21" V-2344			alum.	ES	17,000	no	3	3.35
	14" Portable	11-9/16"x14-7/16"x16-1/8"	27	alum.	ES	13,500	no	3	3.35
	21" 17Z20			gray	ES	15,000	yes	3	3.0
	21" 19Z22			alum.	ES	17,000	yes	3	3.2
	21" 22Z20			alum.	magn.	20,000	yes	3	3.2
	14" Portable	11-3/4"x17"x13-7/8"	26	gray	ES	14,000	yes	3	3.0

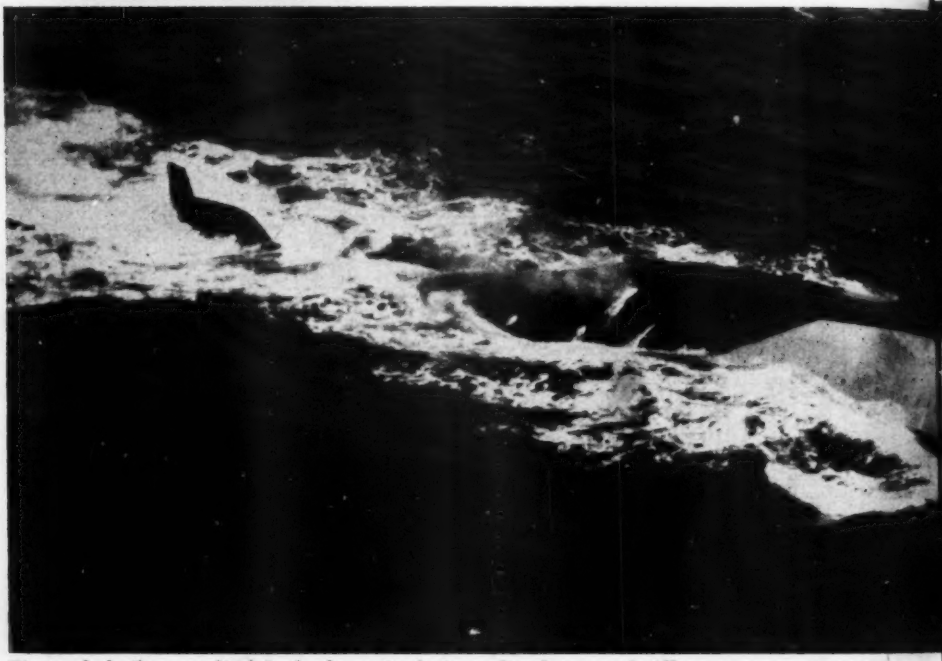
NOTES: (a) ES means electrostatic focus, which is automatic; magn. means magnetic (adjustable) focus (b)Tube filaments wired in two series circuits

PICTURE STABILITY					PICTURE POWER					
AUTOMATIC GAIN CONTROL		NOISE		NUMBER OF ADJACENT	NUMBER OF	SENSITIVITY		NO. VIDEO		
TYPE	CONTROL	KILLER	INTERFERENCE FILTERS	CHANNEL TRAPS	TUBE FUNCTIONS	(microvolts per meter)	TUNER	AMP STAGES	POWER SUPPLY	PRICE
derived	switch	no	1 FM trap	1	20	30	cascode	1	transformerless	$160
derived	switch	no	1 FM trap	1	20	30	cascode	1	transformer	$180
keyed	variable	yes	1 FM trap	1	22	30	cascode	1	transformer	$200
derived	none	no	none	none	18	100	pentode	1	transformerless	$90
derived	none	no	none	none	18	100	pentode	1	transformerless	$110
derived	none	no	none	none	18	100	pentode	1	transformerless	$130
keyed	none	yes	none	1	22	n.s.	cascode	1	transformer	$240
derived	switch	yes	1 FM trap	none	19	60	pentode	1	transformerless	$180
keyed	variable	yes	2 IF traps	3	21	35	cascode	1	transformerless	$230
keyed	variable	yes	2 IF traps	3	21	35	cascode	1	transformerless	$290
derived	none	no	none	none	15	300	pentode	1	transformerless	$120
derived	switch	no	1 IF trap	1	25	n.s.	cascode	1	transformer	$160
derived	variable	yes	1 IF trap	1	28	n.s.	cascode	1	transformer	$220
derived	variable	yes	1 IF trap	3	29	n.s.	cascode	1	transformer	$320
derived	switch	no	1 IF trap	1	25	n.s.	cascode	1	transformerless	$150
derived	none	no	2 IF traps	1	20	15-30	neutrode	1	transformerless	$168
keyed	variable	yes	2 IF traps	1	22	10-20	cascode	1	transformer[b]	n.a.
derived	none	no	1 IF trap	none	19	100-190	pentode	1	transformer	$134
derived	none	no	1 IF trap	none	19	80-150	pentode	1	transformerless	n.a.
derived	none	no	1 IF trap	none	19	80-150	pentode	1	transformerless	n.a.
derived	none	yes	1 IF trap	4	27	30	cascode	1	transformer	$200
keyed	variable	yes	1 IF trap	4	29	20	cascode	2	transformer	$230
keyed	variable	yes	1 IF trap	4	36	20	cascode	3	transformer	$300
derived	none	yes	none	2	22	n.s.	cascode	1	transformer	$195
derived	none	no	none	none	17	n.s.	pentode	1	transformerless	$100
derived	none	no	none	none	17	n.s.	pentode	1	transformerless	$110
derived	none	no	none	1	19	n.s.	pentode	1	transformerless	$140
derived	none	no	none	none	19	300	pentode	1	transformerless	n.a.
derived	none	no	none	none	20	50	cascode	1	transformerless	n.a.
derived	none	no	none	none	19	300	pentode	1	transformerless	n.a.
derived	none	no	none	none	19	300	pentode	1	transformerless	n.a.
derived	none	no	none	none	19	300	pentode	1	transformerless	n.a.
derived	variable	no	2 FM traps	1	21	15	neutrode	1	transformer	$180
keyed	variable	no	2 FM traps	1	23	15	neutrode	1	transformer	$250
keyed	variable	yes	2 FM traps	1	25	10	neutrode	1	transformer	$370
derived	none	no	2 FM traps	none	18	20	neutrode	1	transformerless	$130
derived	none	yes	1 IF trap	2	22	n.s.	cascode	1	transformer	$150
derived	none	no	1 IF trap	1	15	n.s.	pentode	1	transformerless	$140
derived	switch	no	3 IF traps	1	23	n.s.	cascode	1	transformer	$180
keyed	none	no	5 IF traps	1	23	n.s.	cascode	1	transformer	$250
keyed	none	no	5 IF traps	3	25	n.s.	cascode	1	transformer	$300
derived	switch	no	3 IF traps	none	n.s.	n.s.	cascode	1	transformerless	$140
derived	switch	no	3 IF traps	none	n.s.	n.s.	cascode	1	transformerless	$160
derived	none	no	none	1	17	n.s.	pentode	1	transformerless	$125
derived	variable	no	none	1	19	n.s.	cascode	1	transformer	$167
derived	none	no	1 IF trap	none	17	70	neutrode	1	transformerless	$180
derived	variable	no	1 IF trap	2	18	35	neutrode	1	transformerless	$223
keyed	variable	yes	1 IF trap	2	22	20	neutrode	2	transformer	$260
derived	none	no	1 IF trap	none	17	100	pentode	1	transformerless	$115
keyed	none	yes	1 IF trap	none	19	25	cascode	1	transformerless	$180
keyed	none	yes	1 IF trap, 1 FM trap	1	21	25	cascode	1	transformer	$200
keyed	none	yes	1 IF trap, 1 FM trap	1	21	25	cascode	1	transformer	$220
derived	none	no	1 IF trap	none	17	30-75	pentode	1	transformerless	$120
derived	none	no	1 IF trap	none	14	50	pentode	1	transformerless	$90
derived	none	no	none	none	17	10	pentode	1	transformer	$160
derived	none	no	none	none	17	8	cascode	1	transformer	$180
derived	variable	yes	none	1	19	5	cascode	1	transformer	$220
derived	none	no	none	none	17	10	pentode	1	transformerless	$130
derived	variable	yes	none	none	17	30	neutrode	1	transformer	$170
derived	variable	yes	none	none	17	30	neutrode	1	transformer	$240
keyed	variable	yes	none	3	21	10	neutrode	2	transformer	$260
derived	none	no	none	2	21	10	cascode	1	transformer	$200
derived	switch	yes	none	2	25	6	cascode	2	transformer	$270
derived	none	no	none	none	21	15	pentode	1	transformerless	$110
derived	none	no	none	1	21	12	pentode	1	transformerless	$160
derived	none	no	1 FM trap, 2 IF traps	2	21	n.s.	cascode	1	transformer	$190
keyed	variable	yes	1 FM trap, 2 IF traps	2	24	n.s.	cascode	2	transformer	$240
derived	none	no	1 FM trap, 2 IF traps	2	18	n.s.	cascode	1	transformer	$125
derived	none	no	1 FM trap, 2 IF traps	2	18	n.s.	cascode	1	transformer	$130
derived	variable	no	none	none	18	50	pentode	1	transformerless	$150
keyed	variable	no	none	2	21	40	cascode	1	transformerless[d]	$180
keyed	variable	no	none	2	21	25	cascode	1	transformerless[d]	$250
derived	variable	no	none	none	18	50	pentode	1	transformerless	$120
derived	variable	no	none	none	18	35	cascode	1	transformerless	$140
keyed	none	yes	high-pass, 1 IF trap	1	24	8	neutrode	1	transformer	$229
keyed	none	yes	high-pass, 1 IF trap	1	22	8	neutrode	1	transformer	$179
derived	variable	yes	1 IF trap	1	23	n.s.	cascode	1	transformerless	$170
keyed	variable	yes	1 IF trap	3	27	n.s.	cascode	1	transformerless[d]	$280
derived	none	no	1 IF trap	none	17	n.s.	neutrode	1	transformerless	$120
derived	none	no	none	none	20	8	pentode	1	transformer	$130
keyed	variable	no	none	none	30	4	cascode	2	transformer	$190
keyed	none	yes	1 IF trap	1	18	20	cascode	1	transformerless	$170
derived	none	yes	1 IF trap	1	17	30	pentode	1	transformerless	$130
keyed	variable	yes	1 IF trap	1	19	n.s.	cascode	1	transformer	$170
keyed	variable	yes	1 IF trap	2	19	n.s.	cascode	1	transformer	$220
keyed	variable	yes	1 IF trap	2	22	n.s.	cascode	1	transformer	$340
keyed	variable	yes	1 IF trap	1	19	n.s.	cascode	1	transformerless	$130

(c)Push-pull audio output (d)Tube filaments wired in parallel N.A. This information not available at press time
N.S. This information not specified by manufacturer

Fastest Sub

By Gardner Soule



First sub built to radical hydrodynamic design, diesel-powered Albacore can outmaneuver

Plump as a partridge, fleet as a falcon, the Albacore is a new kind of sub that may make all surface ships obsolete.

"SHALL we fly?"

Lieutenant Commander Jon L. Boyes, U. S. Navy, was addressing eight officers and visitors around his wardroom table.

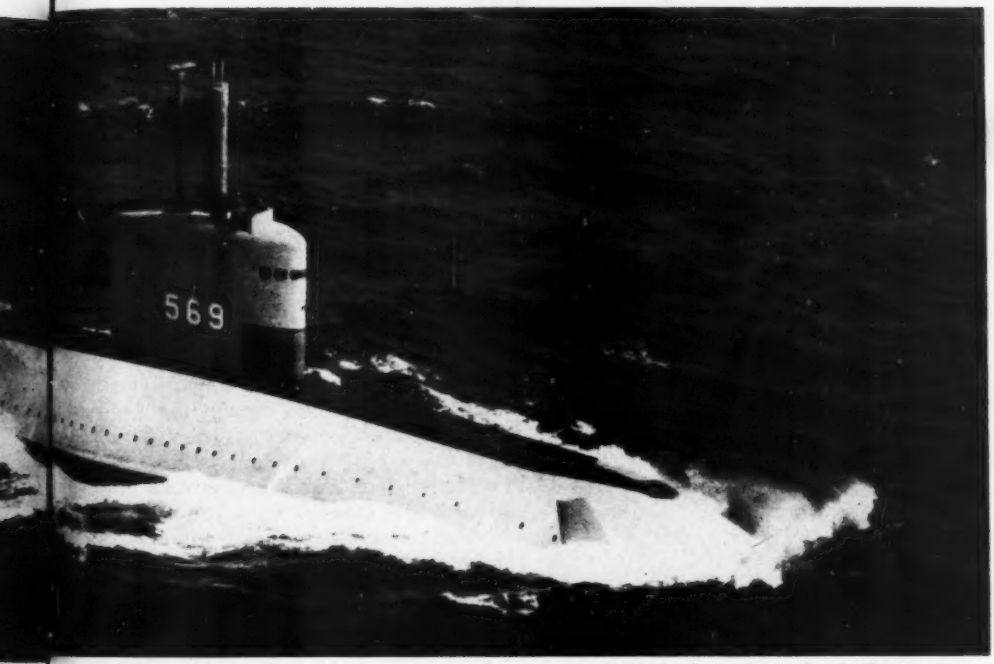
The question was startling, for Commander Boyes is captain of the new submarine USS Albacore—and the Albacore was 100 feet beneath the Atlantic.

But to Boyes, the words were routine. For his ship is the world's fastest submarine. In action she outperforms the atom-powered Nautilus. Though only diesel-electric powered, the Albacore is so fast under water that her maneuvers are called a flight. She brings a new vocabulary of aviation terms to undersea navigation.

Boyes and the rest of us went to the Albacore's flight-control center. Here sit two pilots and a flight-control engineer. They control the bow planes and stern planes (used for diving and climbing) and the two rudders. "Our turning rate," Skipper Boyes tells you, "is faster than a jet plane's."

The controls themselves are borrowed from aviation: sticks with steering

Points Way to Undersea Liners



anything afloat. Six nuclear-powered submarines will be built with similar hulls next year.

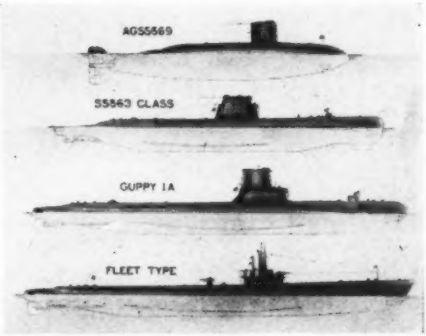
wheels atop them. There is no helm.

"Now hear this," came over the public-address system. "We will be taking angles and heels now."

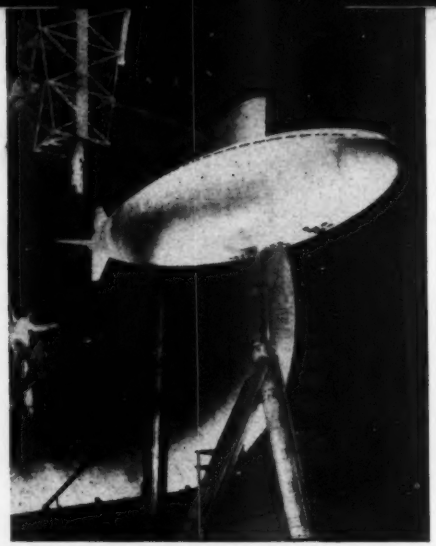
Crew and visitors prepared themselves for rapid movements of the ship. The pilots and flight-control engineer fastened safety belts. The rest of us grabbed handrails or overhead straps.

Boyes spoke to his maneuvering-room: "Make turns for 18 knots." To his senior pilot, Lt. Theodore F. Davis, the Albacore's exec, he said: "Your ceiling is 100 feet. Your floor will be three-five-zero."

The maneuvering-room reported turns for 18 knots. A minute later, Command-



HOW SUB HULLS EVOLVED is shown by these profiles of U.S. types. The Albacore (at top) has a deceptively plump fish-shaped body. But she is superior in underwater performance even to the nuclear-powered Nautilus and Sea Wolf.



NAVY SCALE MODEL shows the clean, stripped hull of the Albacore. She has a single five-bladed propeller instead of twin screws.

LAUNCHING OF THE ALBACORE may well mark a new design era in naval and merchant ships. This high-speed experimental submarine has a

er Boyes ordered Davis: "Go to floor."

Pilot Davis moved his stick. Instantly, but with a silky smoothness, the ship pointed her nose down and almost plummeted for her floor—not the bottom of the sea, but the depth Skipper Boyes had specified. The needle on the depth gauge spun the way the indicator on an express elevator does.

Next, Skipper Boyes had the Albacore ascend, descend, twist and turn, as she approached an imaginary target. "Make full speed," Boyes told the maneuvering-room. Some orders sounded like what you'd expect in a plane: "Peel over to the left." Or: "Right ascent to ceiling."

It was quiet. A book fell to the deck. A coffee spoon rattled. Otherwise everything was so well secured there was no clatter. The motors only hummed.

We visitors were quiet because we were struck dumb. We were, it had dawned upon us, among the first men in history to fly underwater. But that was not all: Here was a ship that could revolutionize marine warfare—for two reasons:

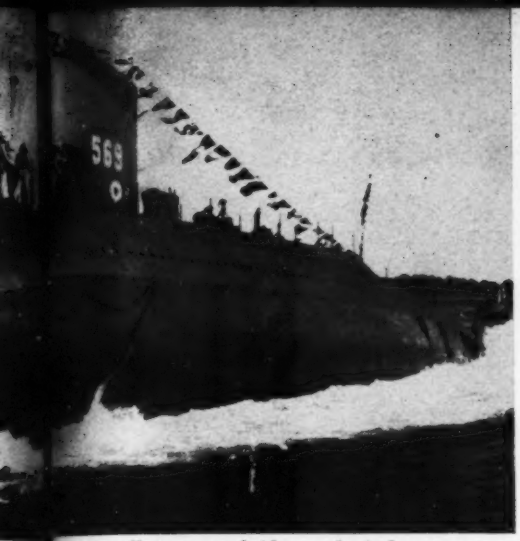
• Her speed. Our World War II subs cruised beneath the sea at eight to 10 knots. Often they had to lie in wait for their prey. The Albacore can chase and catch a surface vessel—and remain hidden while she does so. She can circle most ships and fire at her convenience. If she misses, she can try again. "The Albacore," says Boyes, "has moved us out of the one-shot system."

• Her maneuverability. Because the Albacore flies through three dimensions—turning or zigzagging while diving or climbing—she can outmaneuver any ship of any kind, including the No. 1 enemy of submarines, the destroyer. She can go from dead in the water to full speed ahead in much less time than a destroyer. She can turn in a fraction of the room a destroyer needs.

Submarines of the past had to lie on the bottom when depth-charged. The Albacore will never have to duck an attack. "We'll stay in there and slug it out," says Lt. Jack D. Venable, the operations officer and navigator. Adds Skipper Boyes, "We have the maneuverability and the speed to be attacking, always attacking."

The Albacore had its beginning when the Navy set out, some years ago, to

NEXT MONTH . . .
Now they're sending freight to sea—in the trucks that bring it to the dock. Read "Down to the Sea in Trucks."



small two-man bridge and airplane-type controls. Her slender conning tower is streamlined to knife through the water with least resistance.

design as ideal an underwater hull as possible. The Navy tested 25 hulls—seven to 25 feet long—at the towing tank of the Stevens Institute, Hoboken, N. J., at the David Taylor Model Basin, Washington, D. C., and even in Air Force wind tunnels. Then the Navy decided to build a full-size, 203-foot, 1,800-ton model, to be powered by conventional engines because an atom plant would involve delays.

The result was the Albacore, a working model that has been setting speed and maneuverability records while the atom-powered Nautilus has been grabbing the headlines.

The Albacore has normal submarine engines: diesel for surface travel, battery-power for beneath the sea. She must come up often to charge her batteries.

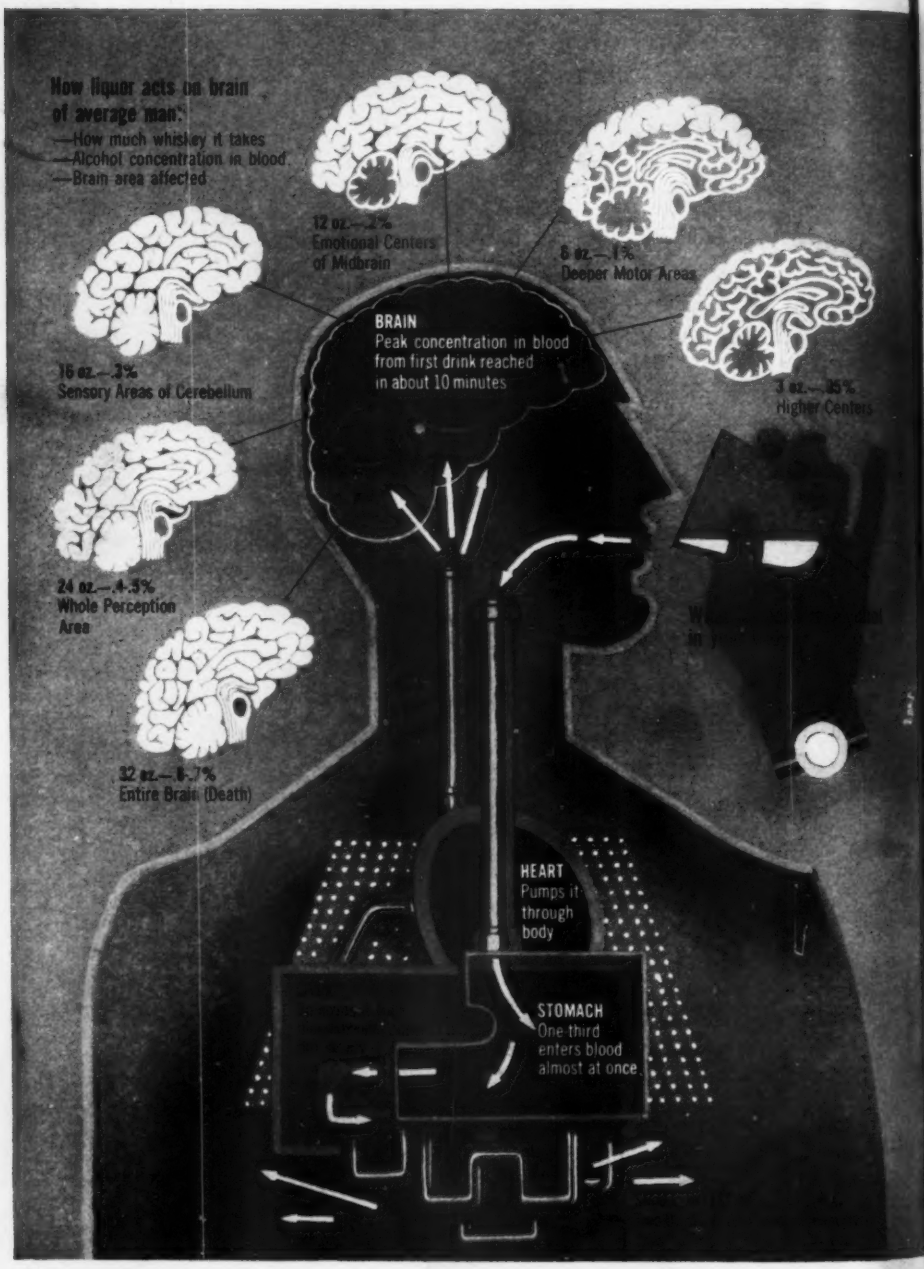
The lessons taught by the Nautilus and the Albacore are already being applied by the Navy. Rear Admiral Albert G. Mumma, Chief of the Bureau of Ships, has announced that six 1957 submarines will have atomic power like the Nautilus—inside Albacore hulls. What those six subs could do to a battle fleet or convoy staggers the imagination.

They could also carry guided missiles. Able to outrun or outfight anything on or

[*Continued on page 226*]

VIEW LOOKING AFT shows a rudder fin above the water as the Albacore makes a test run on the surface somewhere off the Florida Keys.

Here's the undiluted truth, from a top authority, on what your body does to



to alcohol and what alcohol does to you.

What Happens When You Drink Too Much

By Herbert Yahraes

IN THE interest of science, a few years ago, a Yale professor threw two parties in his laboratory. One was for hard, habitual drinkers—a group of derelicts from Skid Row. The other was for light, occasional drinkers—a group of high-school teachers.

The derelicts' party was a dull affair. The guests just sat and drank. They showed no outward sign of alcohol's effect until, one by one, they thudded to the floor in a stupor.

The teachers, though, got happy, some of them even while the drinks were being poured. They joked, laughed, slapped one another on the back, and on two or three cocktails acted tipsy.

But whether, after a few drinks, the guests appeared to be sober as judges or high as kites, an equal number of drinks had given them all approximately the same concentration of alcohol in their blood. Further, by that time, they responded pretty much alike—a little slowly—to tests of the speed of their reactions.

"Obviously there is a difference in the way people behave while drinking," the professor who gave the parties pointed out recently. "But when people are of average size, as these all were, there is considerably less difference in their basic tolerance to alcohol."

The host was Dr. Leon A. Greenberg, then a physiologist on the staff of Dr. Howard W. Haggard, director of Yale's Laboratory of Applied Physiology and founder of the famous Center of Alcohol Studies, which is a division of the laboratory. When Dr. Haggard retired, this past summer, Dr. Greenberg took over. Because of his work with the Center during the last 15 years, he is one of the world's top authorities on what happens to alcohol when we drink it and what happens to us.

Toss off a jigger of whiskey and we'll follow it, with Dr. Greenberg's help.

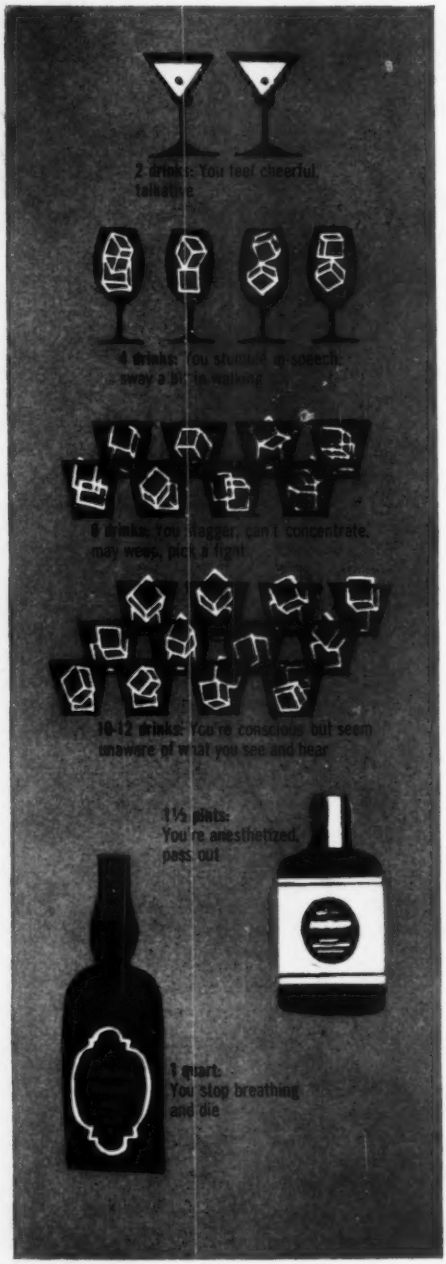
IT GOES down with a burning sensation. (Take your liquor neat over the years, and you'll probably develop the hoarseness that gives rise to a whiskey tenor.)

In the stomach, the gastric juices immediately begin to dilute your drink until the concentration of alcohol drops from 50 percent, if the whiskey was 100 proof, to about five.

We'll assume that you haven't eaten. In that case, about a third of the alcohol passes almost immediately into the blood, entering it through tiny, thin-walled vessels, the capillaries, in the stomach's wall. The rest passes rapidly into the small intestine and is quickly taken up by the capillaries there. Alcohol is the only food absorbed this way—directly from the stomach and the intestines, without digestion. That's why it hits fast.

Next, it passes through the liver, where oxidation begins. This is the process that

When to say when:
What happens to you when you keep on drinking



transforms the chemical energy of food into heat and work. In the case of your drink, oxygen carried by the blood combines with two atoms of hydrogen in the alcohol to form water. This leaves a compound known as acetaldehyde, which is rapidly oxidized—in the liver and everywhere else—first to acetic acid and then to carbon dioxide and water.

IF YOU drink slowly enough, the alcohol will be oxidized by the liver as rapidly as it is absorbed, and you'll never feel it. By spreading half a highball, or three-quarters of a can of beer over 60 minutes, you can drink 24 hours a day without effect.

In your case, though, you've gulped an ounce of whiskey in a few seconds, and the liver can handle in an hour only as much alcohol as there is in three-quarters of an ounce. So most of the alcohol passes through the liver unchanged on the first trip, reaches the heart by way of the veins and is then pumped everywhere.

"Mixing drinks won't make you any drunker than an equal number of one kind. But the mixture of flavors may upset your stomach—and certainly will if you think it will."

WITHIN a few minutes after you've swallowed it, you begin to "feel" your drink, for by that time part of the alcohol is passing through your brain. It's very highly diluted by the blood. Even when the concentration in your blood reaches its peak, in perhaps 10 minutes, it is only a few hundredths of one percent.

The concentration then drops rapidly and the mild kick is soon lost. If you're a large person, of course, you would have felt less effect from the same drink than a smaller man. That's because you have more blood and other body fluids to dilute the alcohol. Anyway, within about an hour and a quarter, as the alcohol keeps passing through the liver, 90 percent of it is taken out and burned for

energy and the other 10 percent is eliminated in the urine and the breath.

IF YOU add water to your whiskey, you escape the burning sensation, but the alcohol gets into your bloodstream just as fast. If you mix the drink with soda water, it will get there even faster, because carbonation speeds the passage through the stomach—which explains why champagne goes to your head so quickly.

On the other hand, a can of beer contains about the same amount of alcohol as an ounce of whiskey but it won't be absorbed quite as fast, even if you take the whole can at a gulp. That's because beer and wine contain solid materials such as protein and carbohydrate, and these foodstuffs slow up the rate at which alcohol gets into the blood. Until it does get into the blood, it can't affect you.

That takes care of what you do to alcohol. Now, what does alcohol do to you?

Years ago, temperance lecturers had an answer: They dropped the white of an egg into a glass of pure alcohol, where it promptly turned into a hard and shriveled mass. Inside you, they implied, the same thing happened.

It isn't so. Even if you drank enough hard liquor to kill you, the concentration of alcohol in your blood and bodily tissues would be only about seven-tenths of one percent.

"That's far too weak," Dr. Greenberg explains, "to corrode or coagulate any part of you. You would die simply because alcohol is an anesthetic and you had taken enough of it to cause fatal anesthesia."

"It's not the alcohol in drinks that gives you a 'breath,' but the other ingredients. Ethyl alcohol has scarcely any odor. That's why it's hard to tell when someone has had a drink of U.S. vodka, which is simply distilled spirits, diluted."

The effect is similar to that caused by a shortage of oxygen at high altitudes.

How to Avoid a Hangover

1. Don't drink.
2. Eat a nourishing meal before you do any heavy drinking.
3. Fortify yourself with protein—a quart of milk or a steak—before a party. Protein takes longer to digest than other types of food, and as long as there is food in the digestive system, alcohol is absorbed less rapidly.
4. Don't drink too much wine. The tannic acid in wine can cause the worst hangovers of all.

With alcohol, as with ether, it begins at the top of the brain—which is the center of fine judgment and coordination, the brake on our behavior—and works down.

SUPERFICIAL behavior while drinking depends on such points as how recently the drinker has eaten, whether or not he feels like celebrating, how much he wants to control his first reactions and what kind of temperament he has.

"The person who is shy when sober may become the life of the party when high," Dr. Greenberg notes, "and the usual life of the party may become a nuisance after a few drinks."

Does alcohol calm your nerves? The Center is in the midst of experiments to show whether or not a little alcohol—the amount found in two or three cans of beer—eases tensions. Many drinkers suppose that it does, and the experiments so far indicate that they are right.

Dr. Greenberg tells the story of the TV producer who ruined the point he was trying to make in a demonstration of the bad effects of alcohol. The producer put a man through a driving test twice in front of the cameras: first without a drink; then after two drinks and a pause.

"I could have told him what might happen," Dr. Greenberg says. "The driver at the start was in a strange situation and nervous. After a couple of drinks, he calmed down and made a better score than he had the first time."

Skills as well as tensions are lowered. A multitude of tests show that after

[*Continued on page 232*]

Winter's Wildest Highway Battle

Here, where two transcontinental roads cross the spine of the Sierra Nevada, Californians wage war against a smothering white enemy.

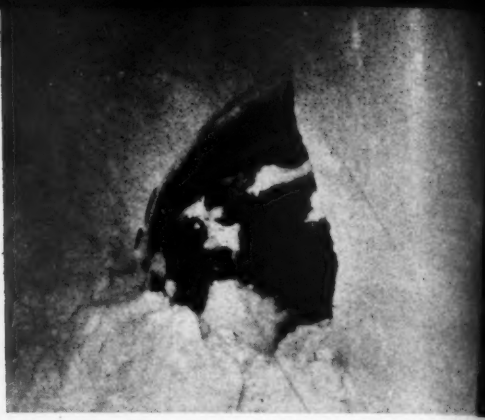
By Wesley S. Griswold

INCREDIBLE snowfalls, as much as five feet in 24 hours, piled into house-high drifts by icy, screaming winds, give a rugged band of Californians the nation's toughest highway-clearing job each winter. Nowhere in the United States is the task rougher than where crucial Routes 40 and 50 wriggle across the back of the Sierra Nevada. As the photographs here and on the following two pages show, the men and machines of the California Division of Highways fight epic conflicts with Nature. The annual battle with the snow is now in its sixteenth winter.

ROTARIES GNAW AT A 15-FOOT DRIFT blocking Route 40. Snow driven by 100-m.p.h. winds sometimes fills the road 25 feet deep.

◀ **ONCE A PIONEER TRAIL,** blazed in 1844, Route 40 is now the chief vehicle route across the Sierra Nevada. This aerial view shows it meandering toward Donner Pass, its 7,135-ft. summit.

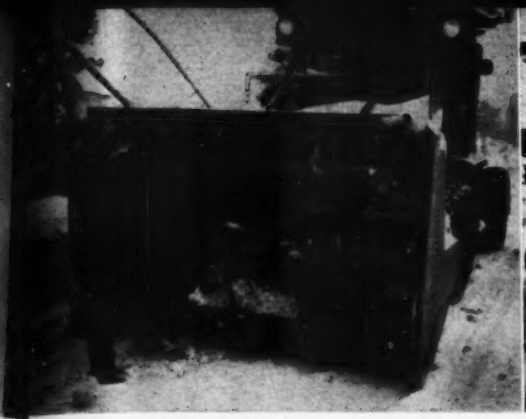
TREACHEROUS OVERHANGS of ice-stiffened snow must be sliced with crosscut saws or blasted or pulled down with looped chains attached to trucks before rotary plows can chew them up.



A CARELESS SKIER left his car beside the highway instead of in a parking area. It was buried by a sudden blizzard and refound only when a rotary's blades savagely sliced into its body.

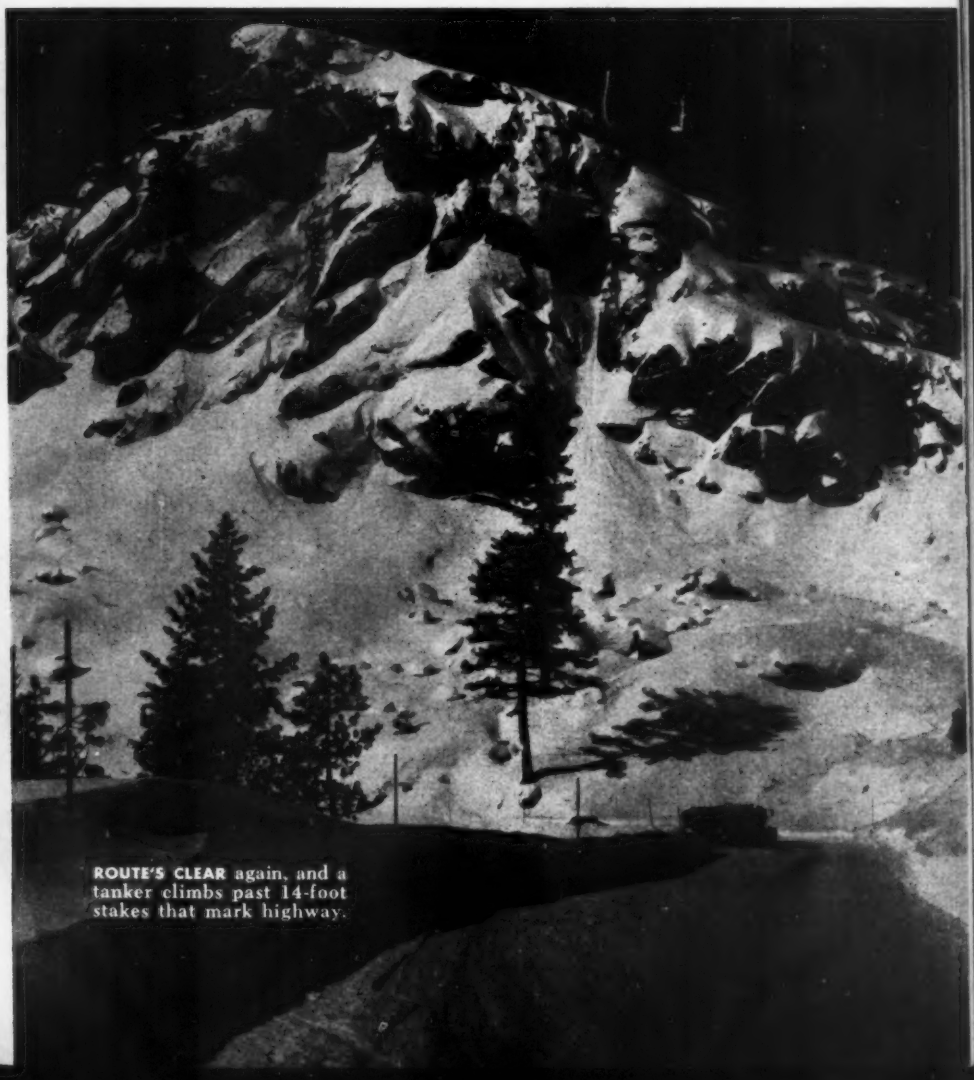
JACKKNIFED TRUCK testifies to the peril of being overtaken by a Sierra storm. When snow begins to fall, highway men soon post "Chains Necessary" signs at both ends of the passes.

AROUND THE CLOCK, in 12-hour shifts, weary men brave snowslides, fallen boulders, uprooted trees and numbing cold to keep blizzards, which often last for days, from gaining headway.



LULL IN THE STORM permits driver of a rotary plow to check the augers that push snow into a whirling fan that spews it 200 feet. The Division of Highways can mobilize 46 rotaries.

TWO-WAY RADIO links the rotaries and most of the 220 additional push-plows, graders and sanders with which the state's highway department battles winter on its mountain roads.



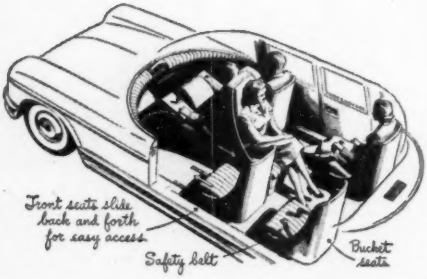
ROUTE'S CLEAR again, and a tanker climbs past 14-foot stakes that mark highway.

This Car Can Crash Without Hurting You

Safety experts show Detroit how to build a car that takes the death out of driving. You could wrap it around a telephone pole and walk away.

THE most radical new automobile of 1957 will be the Cornell Safety Car. There will be exactly one custom-built model, constructed by Cornell Aeronautical Laboratory of Buffalo, N. Y. You'll see it at auto shows.

For eight years Cornell experts have been learning the facts about automobile accidents. Now the Liberty Mutual Insurance Co. has sponsored this car, which is designed around those facts. It includes every device Cornell recommends to make accidents safe for human beings.

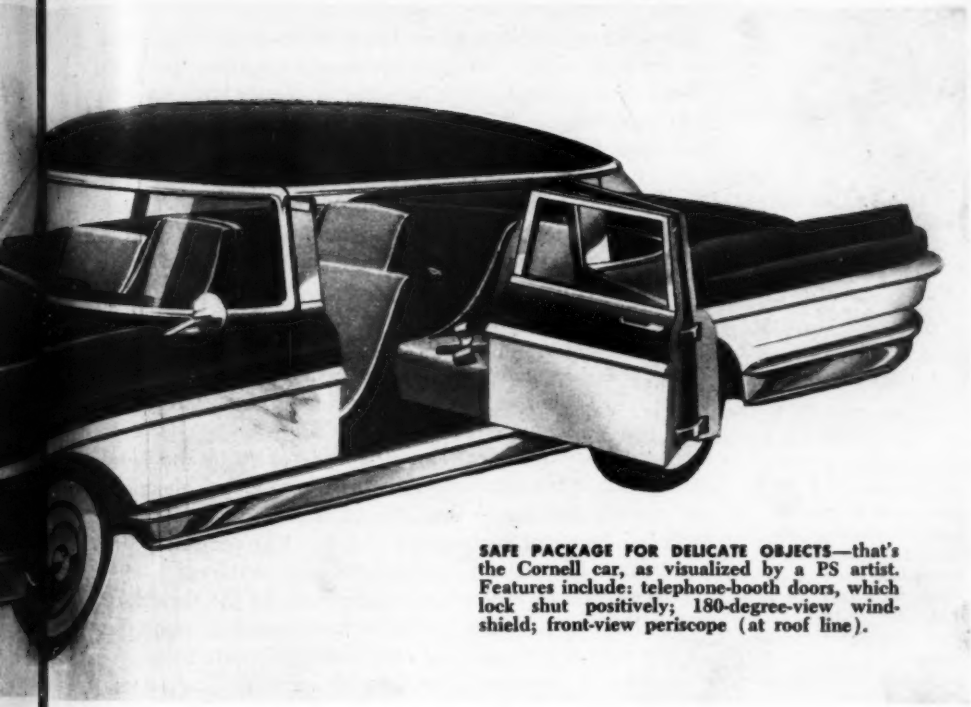


Club-car interior has driver high in center, one passenger facing rear. Everybody is strapped into seats that can't break loose.

Fact: Most deaths in auto wrecks are from head injuries. Tossed against glass or steel, you can be killed even at crash speeds as low as 17 m.p.h. Police-department records indicated this. And by making simulated human heads out of plastic, and dropping them deliberately, Cornell verified how easy it was to smash them.

Devices: Safety belts hold all occupants of the Cornell car in place. The belts allow you to move at the hips only three inches. Bucket seats hold you snugly.

To protect your head still more, the windshield is farther ahead of the driver, and the rear seats, low and between the



SAFE PACKAGE FOR DELICATE OBJECTS—that's the Cornell car, as visualized by a PS artist. Features include: telephone-booth doors, which lock shut positively; 180-degree-view windshield; front-view periscope (at roof line).

fenders, are farther from the roof and from the rear of the front seats. Theoretically, it is impossible for your head to strike anything in the Safety Car, no matter how violent the accident. There's nothing for you to hit against.

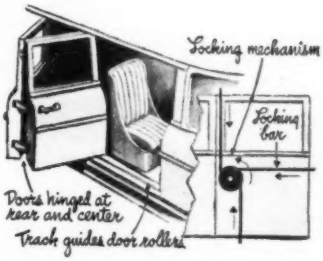
"You should be able," says Ed Dye, chief of the research program at Cornell, "to wrap the safety car around a telephone pole at 50 m.p.h.—and walk away from it. Your passengers should walk away, too."

Fact: Nineteen percent of all injury-producing accidents involve an auto's turning over. Cornell learned this from its own statistical studies.

Device: Roll-over bars, front and back, keep the Safety Car's roof from caving in. They are horseshoe-shaped, like those used in stock-car races, and are made rigid by steel struts tying their open ends, underneath the car. The roll-over bars can support 3½ times the weight of the car.

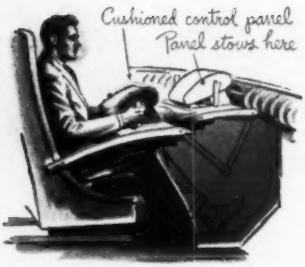
Fact: In a crash, your body is thrown forward and upward. Cornell proved this by wrecking autos containing dummies. High-speed movie cameras recorded the movements of the dummies.

Devices: Seat belts are the answer to this one, but Dye



Door opens wide for easy entry, but can't spring open in crash. Three heavy steel bars lock it into frame.

expects some people to ignore them. So there is also padding on the roof, above the windshield, and covering the dash. There is also extra-heavy padding at places you can butt into especially easily—on the roof just ahead of front and rear seats, for instance.



Controls protect driver instead of endangering him the way present ones do. Cushioned dashboard snaps into his lap. He steers with levers, which turn wheels hydraulically. Cornell reports that levers are easier to use than a wheel.

Cornell's research has differed from any before it. Most attempted only to prevent accidents. Cornell aims at that, too, but also tries to make crashes that do occur harmless to the people in the car.

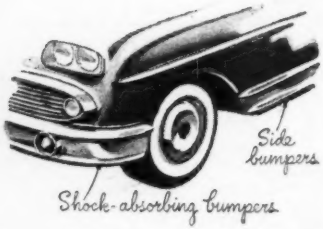
Fact: The driver is alone in any car half the time. Besides, if he always has full control, he can avoid many crashes—and he can prevent many minor accidents from becoming major ones.

Device: The driver's seat is in the front center—not at the left-hand side. It is three inches ahead of, and three inches higher than, the other two front seats. This gives him better protection and visibility. The center driver's seat is, says Dye, "the most drastic change in the car."

Fact: Present wrap-around windshields let the driver see over a 110-degree angle. But he looks obliquely through the sharply curved ends, and his view there is distorted.

Device: A one-piece windshield smoothly curved—no sharp bends. The driver's eyes are in the center of the curve; he has almost a 180-degree view, and he looks straight through every part of the glass, never obliquely.

Fact: "The steering wheel and post," says Cornell's report, "constitute one of the most common injury-producing objects." The wheel rim and spokes are located where the driver's abdomen or head can strike them; the horn ring can break and "present dangerously sharp ends to the vulnerable throat." Lung punctures, crushed chests and broken necks have been common.



Bumpers circle the car, are rounded so bumps glance off. Springs and energy-absorbing material behind bumpers lessen impacts.

Dye is more blunt: "Today's steering post is a harpoon aimed at the driver's chest."

Device: A padded control panel replaces the steering wheel. It fits against the dash when the car is parked. You pull it down and click it into place in your lap to drive.

On each side of the control panel is a lever. You steer with either hand, moving one of these levers forward or backward. "Bobsled steering," Dye calls it. Steering is by power, and moving either lever three inches gives you the sharpest turn possible.

Cornell tests showed that this method of steering was also far easier to learn than the use of the wheel.

Fact: Protruding objects inside a car—keys, knobs, etc.—cause many injuries.

Device: Recessed buttons replace knobs. Radio controls are recessed in one side, shift buttons in the control panel itself. The ignition key goes at one end of the control panel, where no one can strike it.

Fact: Some accidents occur, the experts at the Cornell laboratory point out, because the driver's foot misses the brake pedal or slips off it.

Device: The brake pedal is a wide bar that stretches two-thirds of the way across the control panel. You can reach it instantly and unmistakably with either foot or both.

The accelerator, the only other thing you operate with your feet, is where it is today: under your right foot.

Fact: A large share of collisions involve the front end.

Device: A front-view mirror where the rear-view mirror usually is. It looks ahead through a horizontal periscope running to each side of the car, lets you peek around the truck ahead without crossing the center stripe. Rear-view mirrors are out on each fender.

Fact: Some accidents happen when the driver takes his eyes off the road to check dashboard instruments.

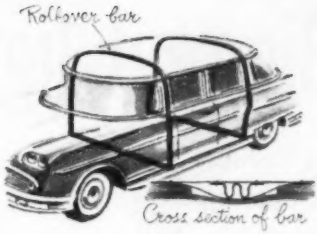
Device: A simpler instrument panel. In dead center is the only thing the driver needs to consult most of the time: the speedometer. Its needle is fixed in the center, and a numbered dial revolves. The driver glances at the same needle-point every time he checks his speed. "You can read the speedometer," says Dye, "with the least possible distraction from the road."

Beneath the speedometer are the other gauges: gas, oil, ammeter, temperature. Over each is a single bar that lights up. The bar normally glows green—when the gas tank is one-fourth or more full, for example. When trouble brews—as when the gas is low—the bar turns red to attract attention.

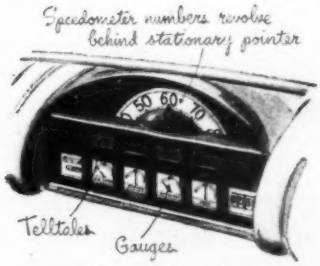
There are also a mileage indicator and a clock on the panel. The clock shows figures—like 5:28—instead of harder-to-read hands.

Fact: Doors that open in crashes let people fly out to their death. Indiana police found one or both front doors had opened in 72 percent of fatal accidents. North Carolina and Maryland police reported the same thing happened in 44

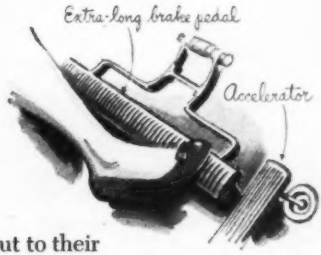
[Continued on page 254]



Stock-car racers' roll-over bars are built inside Cornell car. They are bolted between roof skin and roof padding. You should be able to tumble into a ravine with nothing worse than a shaking-up.



Only the speedometer is big. It has a fixed pointer and a moving dial. Other gauges have both dials and warning lights.



Nobody could miss this brake pedal—it stretches two-thirds of the width of the control panel.

The Dead Sea Scrolls

Biggest Jigsaw Puzzle Makes

By Gardner Soule

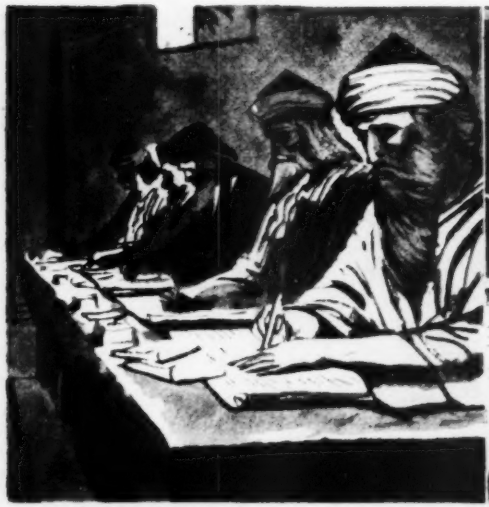
SINCE 1947 the Dead Sea scrolls have been in the headlines. You will be reading about them, says Dr. Millar Burrows of Yale, for 50 to 100 years more. To scholars their value is ageless.

Dr. Burrows, a Biblical historian and a past director of the American School of Oriental Research, Jerusalem, explains the significance of the most fascinating scientific detective story of our time:

"For the first time, we have the complete library of one group of people who lived at the time of Christ."

We know these people were Jewish, but we are not yet sure exactly who they were. We do not know many things about them: for instance, where they got the wealth they apparently had. We do not know for sure that they had any direct contact with Christ. We do know they lived in the heart of the Holy Land: Qumran, where the scrolls were written and discovered, is 15 miles from Jerusalem, 15 from Bethlehem, 7½ from Jericho, 15 from where John baptized Christ in the Jordan River. People living there might have known, taught, or learned from, Jesus.

We do not even know how many Dead Sea scrolls will be found. At first, there were seven. One was a Manual of Discipline, i.e., customs of the Qumran people. One contained their Thanksgiving psalms, or hymns. One told of a forthcoming Jewish-Roman war, and advised



About 100 B.C. Perhaps a hundred years before the Star rose in the East, men at high stone tables dipped reed pens into ink of lampblack and gum, and copied the holy works of their sect. Writing in Hebrew and Aramaic on thin sheets of leather sewn into rolls, and on papyrus, they inscribed the Old Testament, works of prophecy, prayers, psalms, their laws.

4 B.C.-31 A.D. Upon the scrolls, the Qumranites recorded some of their beliefs. We preach, they wrote, poverty, penitence, humility, baptism. Because of these things, some people think they were the Essenes, a Jewish group known to have lived on the western shore of the Dead Sea, who held such beliefs. They may, however, have been another Jewish sect.

a Picture of Christ's World

Jews how to fight it. The other four were copies of, or commentaries on, books of the Old Testament.

Soon, there were nine scrolls. Then there were 10. Now there are parts of 400—some represented by scraps the size of a postage stamp. These—chewed up by rats, or rotted by time, dirt, and weather—are being put together in Israel and Jordan.

This amounts to the biggest jigsaw puzzle in history. It will take 10 years, Burrows says, just to get together and translate the scrolls so far found. Then will come years more of headlines based on interpretations of the scrolls.

The years of headlines will come partly because the scrolls include the oldest Biblical manuscripts known, 1,000 years older than any others. The first Biblical documents we have ever had—with the exception of one small fragment—that were actually written before, and during, Christ's lifetime, they will shed light on the beginnings of Christianity. Written by Jews, the scrolls are equally important to Jewish researchers. Found in Mohammedan Jordan, they are of concern to Moslems. There is not a single nation or man in the western world upon whose history or religion they do not have bearing.

Even though the scrolls today present a thousand unanswered questions, much has been learned about them and the men who made them. The story, as so far reconstructed by the scientists, is told in the pictures that follow.

67-68 A.D. There came to pass the war between the Jews and Romans foretold by one scroll. The men at Qumran, scientists believe, got word the Romans were marching toward them. They gathered up the scrolls, deposited them in jars in nearby caves—where possibly they had been accustomed to bury sacred documents—and may have hid alongside the scrolls.

68 A.D. They wrote down, not on leather but on scrolls of more permanent copper, the location of millions of dollars' worth of treasure they buried. Sample: "In the cistern, which is below the rampart, on the east side, in a place hollowed out of rock; 600 bars of silver." There were at least 60 such hoards of precious metals and incense. *(Please turn the page)*

The Dead Sea Scrolls

70 A.D. The Roman 10th legion, mopping up resistance around Jericho, captured and burned the Qumran community. The war was over. Jerusalem was destroyed. In Rome, the Arch of Titus—named after the victorious Roman general—went up to commemorate the victory. (New York City's Washington Square Arch is patterned after the Arch of Titus.)

February 1947 Not for almost 1,900 years did men find the records the Qumran people had deposited. Then it was accidental. Two Arab shepherds came across a cave they'd never seen before, tossed in a rock, heard pottery smash. They entered. Inside there were covered jars, containing seven linen-wrapped scrolls. Bits of other jars, broken, lay strewn around.

March 1948 Trever and Brownlee hardly dared to believe the evidence of their eyes. They photographed one of the scrolls, a copy of the book of Isaiah, sent pictures to famed Bible scholar Prof. William F. Albright of Johns Hopkins. He backed up the date they had attributed to the manuscript. He added: "The greatest manuscript discovery of modern times!"

1948-54 The four scrolls the Americans saw had been bought by the Syrian Orthodox Metropolitan, Samuel, of St. Mark's Monastery, Jerusalem. On his own, the Metropolitan brought them to the U.S. to sell. But his price was high: a million dollars. For six years he found no customers. Then one day he decided to put an advertisement in the *Wall Street Journal.*

Summer 1947 The scrolls found by the shepherds were brittle, decomposed, and in strange writing. They smelt bad. The shepherds, who were wandering Bedouins, knew not what they had. In the markets of Bethlehem, they passed around the scrolls, sought tips as to who might buy them. They offered the scrolls to a dealer in antiquities for $56, but he refused.

Feb. 19, 1948 At length, four scrolls were shown to John C. Trever and William H. Brownlee of the American School for Oriental Research, Jerusalem. In a hotel room, they compared the scrolls with slide photographs of the then-oldest-known Hebrew manuscripts. Staring at the ancient script, they gasped. They were forced to conclude that the scrolls were of Christ's time.

1954 In New York, the ad was seen by William Cohen, an agent of Hebrew University, Jerusalem. Friends of the university bought the four scrolls for $250,000. Meanwhile, Prof. E. L. Sukenik of the university had bought the other three scrolls from a dealer in Bethlehem. Thus all seven manuscripts have been brought together again at Hebrew University today.

1948-Today The great value of these finds did not remain secret. The Dead Sea grapevine was at work. Arabs, spurred by visions of sudden wealth, scoured the numerous caves along the sea. Hundreds of fragments were brought to dealers and scholars. Some were torn because the Arabs thought they could make more by selling a piece at a time. *(Please turn the page)*

1948-Today Simultaneously, scientists and men of religion searched the area. One cave, reached by a slippery path down a cliff and designated No. 4 Qumran, turned out to be a man-made chamber hollowed out of the cliffside. A jackpot waited here: parts of no less than 70 scrolls. "A terrific collection," says Prof. Millar Burrows. "Maybe a 'publishing center.'"

1949-55 Half a mile from the first cave, archaeologists excavated a set of ruins, once a monastery for the Qumran sect. "Stone by stone," says G. Lankester Harding of the Jordanian Department of Antiquities, "they found the rooms in which these people lived." Here they had made their pottery, too: A jar just like those in the first cave was unearthed.

February, 1956 One of the first scrolls was so stuck together that scholars despaired of unrolling it. At Hebrew University, Prof. James E. Bieberkraut softened it by exposing it for months to controlled humidity, slowly peeled it open. It was a part of Genesis, written in Aramaic, and the earliest document ever found in this ancient language that Christ spoke.

1952-56 William L. Reed, Professor of Old Testament at Texas Christian University, in 1952 took two days to dig his way into a cave that had been hidden by an earthquake. He found fragments of pottery, and something else: two copper scrolls—one of them actually two scrolls rolled together. They were so oxidized that it was to take four years to read them.

1949-55 This seemed to be the place, also, where they had written their scrolls: The ruins of Qumran held the stone writing desks, benches, ink pots, even dried ink used by the ancient scribes. Coins and pottery dated the ruins to the years just before, during, and just after Christ. Arrowheads and ashes, mixed together, told a grim story of Roman conquest and burning.

1955-Today In the area where Christ had lived, the Qumran ruins are the first building of His time ever dug up. The second, south of Qumran, is the palace (above) of Herod the Great, puppet king of Judea. It is now being excavated. Here, on pottery, papyrus, and on stone chests, is writing like that of the scrolls—further confirmation of their early date.

June, 1956 The copper scrolls were taken to Manchester University, England. They were coated with a transparent plastic to toughen them, and sawed through. They listed the treasure: 200 tons of gold and silver, buried in the region between Hebron and Nablus in Jordan. Where did the Qumran men, who preached poverty, get such wealth? No one knows.

Future The treasure may never be found. The country has changed too much. But this is of small moment. The real treasure lies in the scrolls themselves, written by men who lived in Christ's time, and may even have known Him. These fragments, pieced together, provide a fresh insight into the spiritual currents that have become modern man's mainstream. END

What makes the pointers go around? How do you read them? Here's the inside story of

How Your Electric Meter Works

WHENEVER you turn on a lamp or appliance, a little aluminum disk in your electric meter revolves. It drives the pointers, on the meter dials, that tell how much electricity you use.

You can see the disk going 'round, in a slot at the front of the meter. To see more, you'd have to take the meter apart, and your electric company would take a dim view of that. But your meter's ingenious works are worth looking at, and the photos and diagrams on these pages show you what they're like.

Your meter measures kilowatt-hours of electrical energy. Ten hours' use of a 100-watt table lamp, for example, adds up to 1,000 watt-hours or one kilowatt-hour. Of course your meter doesn't know or care whether you use the energy in a lamp, a heater, or a power tool. It just does the tallying.

Two sets of connections tell the meter what it does need to know: how many amperes of current you're drawing from the wires, and the voltage of the electricity entering your home. All the current you use passes first through the meter's "ampere coil," a turn or two of heavy wire, which is connected in series with the household wiring. Connected across the power-supply wires is the meter's high-resistance "voltage coil," of many turns of thinner wire.

Heart of the meter is a small induction or eddy-current motor. The meter's revolving disk, of solid aluminum, forms its rotor. A pair of electromagnets, whose windings are the ampere and voltage coils, make up its stator. C-shaped permanent magnets provide a brake, overcome by the driving force.

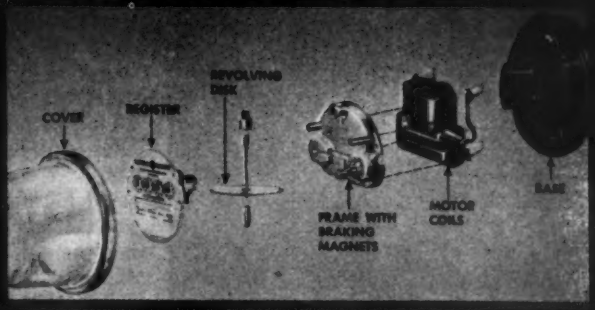
What results is a midget mechanical brain, beautiful in its simplicity, that solves the familiar equation: *watts* = *volts* × *amperes*. For the ampere and voltage coils' combined effect turns the disk at a speed exactly proportional to the number of watts you're using.

Every revolution of the disk indicates an exact number of watt-hours consumed. In the modern AC meter pictured here, one revolution equals 3.6 watt-hours. So, to register one kilowatt-hour, the disk revolves 277 7/9 times.

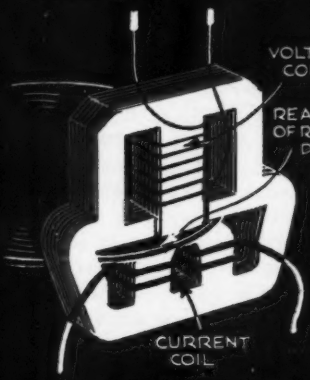
Today a typical household AC meter has a rated capacity (although it doesn't mind a substantial overload) of 15 amperes at 240 volts, which is equivalent to 3,600 watts. That much wattage spins the disk at 1,000 revolutions per hour or 16⅔ r.p.m., just half the speed of an LP record player's turntable. A 200-watt electric blanket or ventilating fan turns the disk at less than one r.p.m., slower than the second hand of your watch.

For accurate response to modest wattages, friction must be all but eliminated. Westinghouse mounts the meter's disk on sapphire jewel bearings; General Electric, with a permanent-magnet suspension that floats it in air. Almost negligible is the friction of the pointers' gearing, and air resistance to the disk's spinning. But even so delicate a mechanism as

If you could take your meter apart, here's what you'd find:

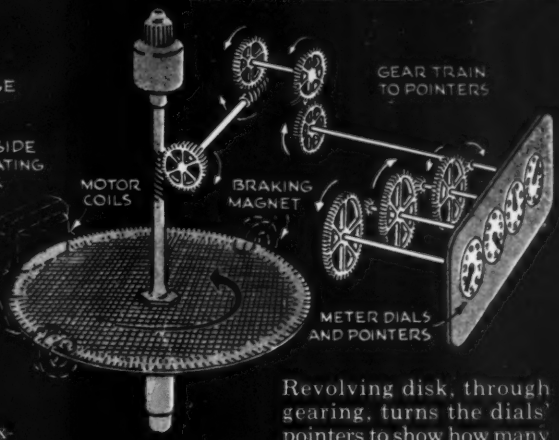


This is the motor that makes your meter go



Aluminum disk turns at speed exactly depending on wattage drawn through simple induction motor.

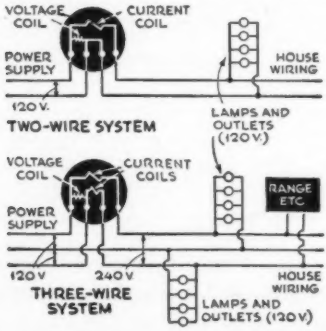
Here's how your meter registers



Revolving disk, through gearing, turns the dials' pointers to show how many kilowatt-hours of electric energy you've used.

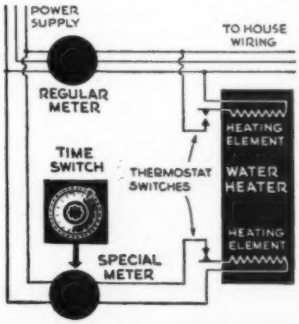
Your meter is connected this way

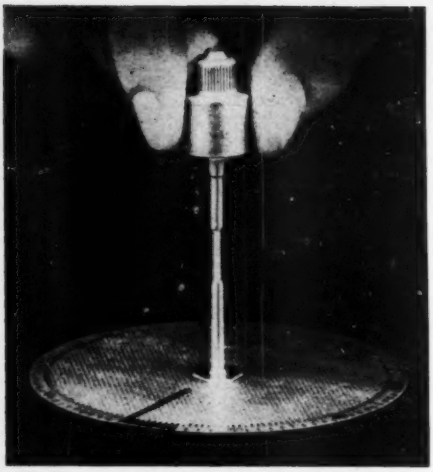
All electricity you use goes through your meter's current coil. Its voltage coil is connected across line. Plans show two-wire system and more modern three-wire system.



This meter watches clock

For low-rate water heating, separate circuit is energized during "off-peak" night hours, by clock and time switch in its own special meter.





MAGNETIC SUSPENSION provides virtually frictionless bearing for rotating disk of General Electric meter, by floating it in air. Other makers mount the shaft on jeweled bearings.

this meter disk has limits of sensitivity.

Possibly you might get some electricity free, if you were content to turn on nothing in your home but an electric clock. Its mere two watts—not enough to turn the meter disk once in an hour—might even "sneak past" the meter without starting it. But that doesn't worry your electric company. At a rate of eight cents a kilowatt-hour, it would take a clock 62½ hours to use one cent's worth of electricity.

An outstanding change of recent years has been the enormous increase in a household meter's rated capacity. Twenty or 25 years back, this was typically for five amperes at 120 volts, equivalent to 600 watts. Today's meter has six times this capacity, and reflects the demand of homeowners for more and more kilowatts to run TV sets, electric ranges, freezers, air conditioners.

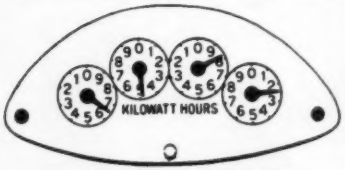
Its 240-volt rating has the same explanation. To provide for increasing electric consumption, modern 240-volt, "three-wire" systems of house wiring have been replacing older 120-volt, "two-wire" systems. Without overtaxing meter or wiring, the newer system delivers thousands of watts—to a range, for example—at 240 volts. It also provides 120-volt circuits for lamps and outlets.

There are meters that watch the clock, too. In many localities the demand for electricity, varying with the time of day, drops off sharply during night hours. Some electric companies offer customers a reduced rate during these hours as an inducement to use more "off-peak" power. Thus, for instance, a customer can economically run an electric water heater during the night for next day's supply. The heater has a separate circuit and a special meter containing an automatic time switch, preset and sealed by the electric company. Should heat ever be needed during the day, while this circuit is dead, a second element in the heater can be operated from the regular house wiring and meter.

What's ahead in meters? Perhaps no meters at all, is one prediction. Looking into the future, some foresee "unmetered billing" for electricity, at a flat rate based on maximum demand at any one time during a month. But electric companies say that day is still far distant. END

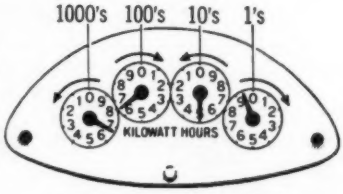
NEXT MONTH . . .
Doorbell dead? PS shows how to bring it back to life or substitute modern chimes.

How to read your electric meter



Reading above: 6,482 kw-h.

You read the pointers from left to right. Notice that adjacent ones turn in *opposite* directions. (A preceding diagram shows you why.)



Later reading: 6,649 kw-h.

Successive readings' difference is amount of electricity used—in this case, 167 kilowatt-hours.

Invitation to Inventors

A NEWLY revised list of things the armed forces would like to see invented includes 245 items, from simple fasteners to an entirely new concept of communication that doesn't depend on electrical impulses, electromagnetic waves, or sound.

Inconspicuous rocket. The list is a frank appeal for the "creative layman" to put on his thinking cap. New weapons are not what the Army, Navy and Air Force are mainly looking for—although they would like, say, a rocket that fires without noise, flash or smoke. Many items are things we'd all like to see 'em make, such as a device to deflect rain from windshields without impairing the vision of a pilot—or the man behind the wheel of the family car. Or a gadget that would serve as a bolt without needing the usual amount of turning. Or a chemical that would rapidly melt coatings of ice or snow at temperatures around 65 degrees below zero.

Many needs reflect spreading military operations in the Arctic: a sleeping bag in which a sleeping man could turn over without awakening; a device, not a mask, to protect a man's head and face in extreme cold; a substitute for wolverine fur as the ruffing on the hood of a parka; a device that would quickly anchor guy wires in ice or frozen ground.

Automatic smeller. The military is also nosing around for an odor-analysis device that will be an improvement over sniffing. The object is to find ways of ignoring simply obnoxious smells, while leaving detectable such valuable alarm odors as leaking gasoline. Also wanted in this category are simple, lightweight devices to indicate the presence of carbon monoxide or to signal the danger of unconsciousness from the lack of oxygen.

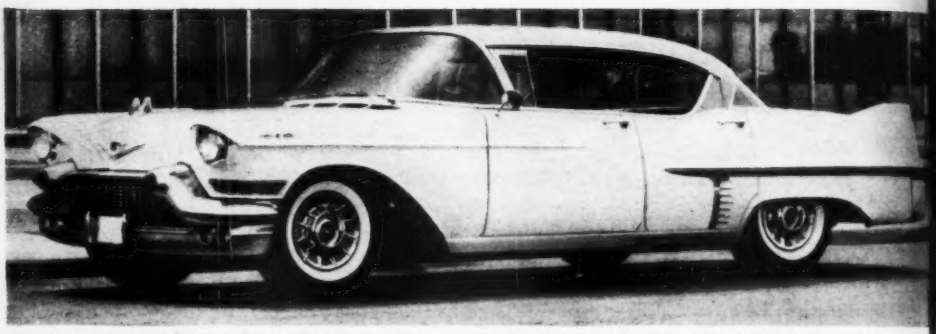
There is variety in the desires of the military:

- An airplane paint that reflects heat while still being highly resistant to it.
- A permanent anti-static coating for plastics.
- Something to protect stainless steel from oxidation at temperatures above 2,000 degrees.
- Lightweight sound-absorbing material that would also serve as armor plate and insulation.
- Luminous material that will glow without external excitation.
- A "fatigue detector" that would tell in advance when a highly stressed metal part is getting ready to break.

Then, of course, there is always the death ray, which still hasn't been invented. It should be small, use little power, and be effective at 500 yards.

If you have any ideas along these lines, or want to know more about what inventions are wanted, write to: The National Inventors Council, U. S. Department of Commerce, Wash., 25, D. C.

X Marks the Frame in the New Caddy



CHROME-CAPPED FINS replace fishtails on this Sedan De Ville. Windshield pillars slant forward for better visibility. The hood, below the fender line now, is down 3½ inches.

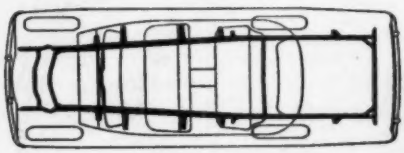
THE people who build that big hunk of elegance called the Cadillac began looking biliously at the frame of their vehicle about four years ago, and the more they looked, the more thoughtful they got. The frame was a rectangle, and it was braced with a big X in the middle. The X, over a period of years, had been supplying more and more of the frame strength, and the sides of the rectangle less and less. What were the sides there for, anyway?

Well, these things take time, and it was not until last month, when the 1957 Cadillacs were announced, that the results of this gnawing self-criticism became evident. An amputation had been performed. The sides of the rectangle—the side rails—had been cut from the Cadillac frame. Only the big X remained.

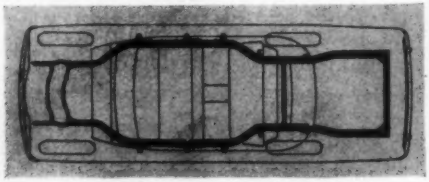
This represented a revolution in passenger-car frame design, the second in the last half-century. The first was, of course, the integral frame-in-body "unitized" construction introduced in this country by Nash.

The new Cadillac frame saves a little weight, and is stronger than the old one, but these were not the main reasons for the change. What Cadillac was after was a way to solve a problem that has plagued automobile builders—the ones who used conventional frames, that is—for more than 20 years. In a nutshell, it was how to provide room for that portion of your anatomy called the tibia,

How today's frames vary in shape and in bracing

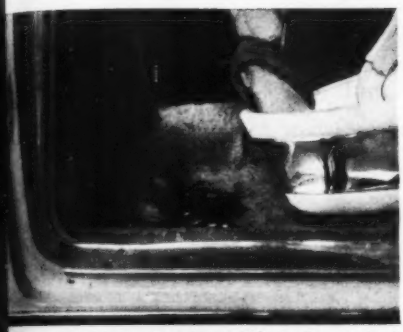


Ladder type, cross-braced



Bulged type, cross-braced

Look—no side rails! New lighter, stronger X frame carries a lower, plushier Caddy.

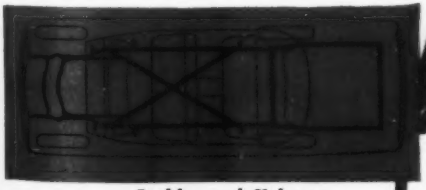


FLOOR STEPS DOWN 2½ inches in back for more leg room, is flush in front.

the principal bone from your knee down.

Tibias weren't a problem before the early 1930's. There was plenty of room in a car for them and the feet attached to them. Or, as a design item, there was plenty of room for seats that were high enough to make your lower legs comfortable.

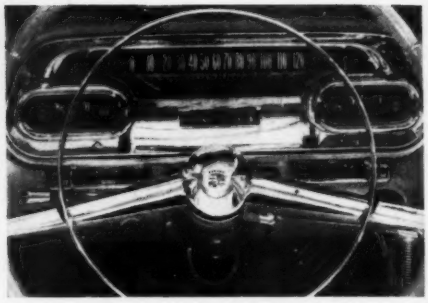
But then the car manufacturers began lowering their roof lines, and Detroit was in hot water. And the real trouble was those side rails, the long metal beams on the rectangles of the frames. They had to have ground clearance. Give them that, put a floor



Ladder and X brace

Cadillac's X frame

SPRING SHACKLE is anchored to box-section outriggers. Exhaust pipe, moved from the side rail, now hugs the X member through the hole at left. Two-piece prop shaft helps lower car.



STEERING WHEEL is deep-dished for safety. Relocating control knobs protects passenger against impact injury. Foot-operated pedal replaces knee-height parking-brake handle.

on top of them put seats on top of the floor, put people on the seats and give them adequate headroom—and the engineers could only snort at stylists who insisted on lowering the roof.

The engineers did do a number of things to arrive at a solution. They cut the ground clearance. They lowered the seat heights. They reduced the headroom. They thinned down the side rails. One manufacturer, Hudson, lowered the roof by putting depressions in the floor for a "step down" to accommodate tibias, a notion that has been copied in a number of automobiles for 1957.

Depressing the floor seemed like a dandy idea, but it was not an unmixed blessing. That was because the body of a car has a frame, too, and the car frame and the body frame must be mated. The point on the body frame where it's attached to brackets on the car frame is called a rocker panel. The rocker panel has width. So has the car-frame side rail. Put the rocker panel cheek-to-cheek with the side rail, and you've got inches of combined frame to hurdle before you reach the depressed floor.

Cadillac, muttering that darn-it-all, there must be *some* way of solving all this, finally began experimenting with a car frame that was just a plain simple X. A Caddy riding on an X frame has been roaming the 48 states for three years now, and the engineers in charge of the road-testing program report that it performed just fine.

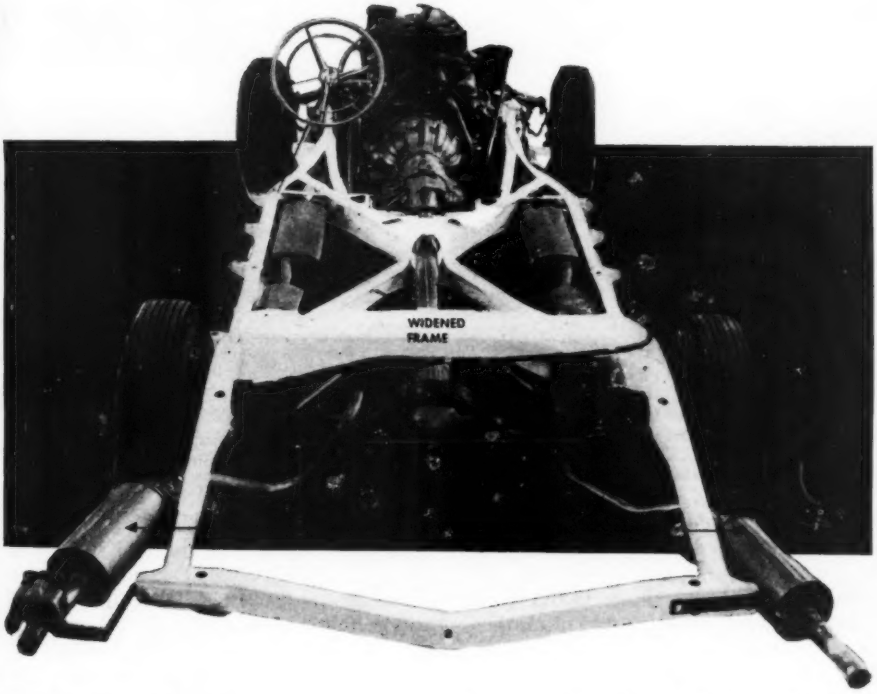
The X frame has a lot more torsional rigidity, which is a fancy name for resistance to twisting—as when one front wheel hits a bump. It has more beam stiffness, which is another fancy name for resistance to fore-and-aft bending—as when both front wheels hit a bump.

The X frame has helped Cadillac drop its car heights as much as 2.9 inches, without incurring the penalty of a wide step-over to reach a depressed floor. It has also made possible a stronger body and a stronger door anchorage on its hardtops because the stub pillar at the center can be huskier. In sizing it, allowance doesn't have to be made for intrusion of the side rail. That's important in the company's new cars because on *all* of them, with the exception of the limousines, the roof-to-floor center pillar is gone. Even the four-door sedans will be hardtops.

They are as elegant as ever, these cars, in brand-new dress for the first time in three years, and the horsepower is at an even 300. Buick, too, is at 300 horsepower for 1957, and Chevrolet's hottest number is clear up to 283. So Cadillac, perhaps unconsciously, has now reduced the "horsepower race" to its ultimate absurdity. Only as regal a boat as the Caddy could do that and get away with it.

About their new frame, the Cadillac people are pretty smug. They say just wait—a lot of the other automobile manufacturers will have what they've got, in 1958.—*Devon Francis.*

Buick Puts New Wrinkle in Torque-Tube Drive



By Devon Francis

THE 1957 editions of the Buick automobile were announced last month, and there was no mistaking that they were the genuine article. They had those things on the fenders, and on the sides, and that front end.

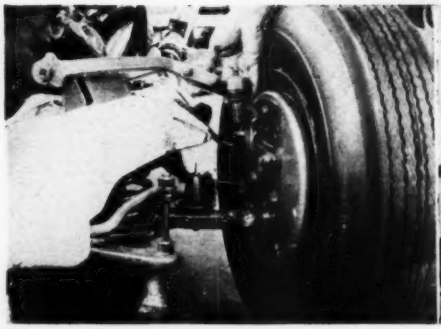
But those things, and the classic rear-wheel cutout, were about all that was recognizable. Buick's builders hardly could have made a greater number of changes if they had jacked up the hood ornament and built an entirely different car underneath.

The overall height is down. The two engines available have more sass. Ball joints have replaced the kingpins in front, and more than half the dive in sudden stops has been engineered out. The frame is new. So is all the sheet metal.

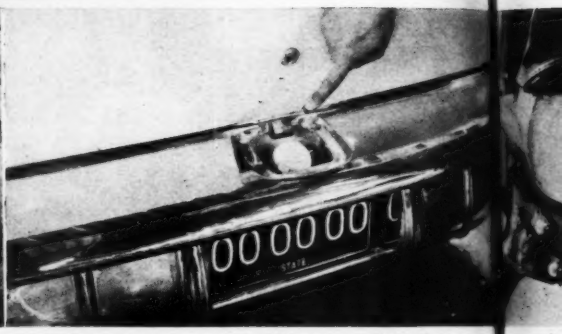
First off, the engines:

That in the little Special, the modest model in the line, puts out 250 horse-

Lower and sleeker, the '57 Buick still retains traditional lines



BALL-JOINT SUSPENSION makes handling easier, boosts front-end stability. Buick is one of the makes that didn't adopt new 14-inch wheels.



GAS-TANK FILLER is centered at rear of body. Cable-reinforced rubber tubing is used for fuel feed line to the engine to prevent rust-out.

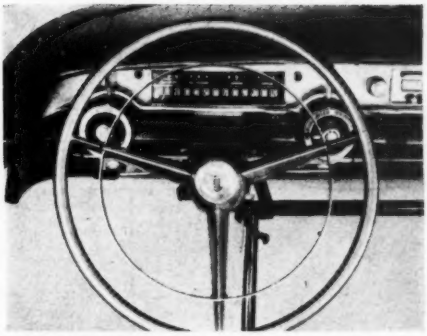
power, up 30 from 1956, and that in the Super, Century and Roadmaster, 300, up 45. To get those boosts, Buick did more than just bore bigger holes in the block. The holes *are* bigger, by .125 of an inch, for a displacement of 364 cubic inches. That's 42 cubic inches more than in 1956.

But the stroke has been lengthened, too, by .2 of an inch, with a consequent increase in rod length and block height. The compression ratio was boosted from 8:1 to 9.5:1 in the Special, and from 9.5 to 10 in the other three cars, by raising the height of the piston domes. The valves are bigger and lift higher off their seats. And the whole exhaust manifold area has been stretched. The engine has to work less to get rid of burned gases.

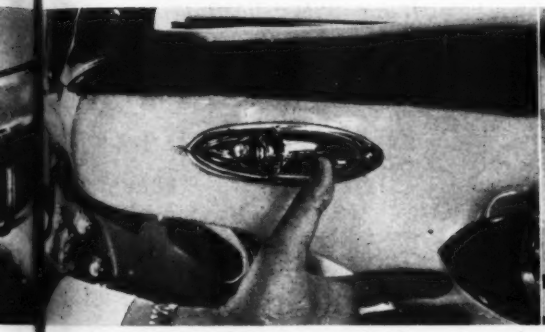
All these shenanigans were not without purpose. The zero-to-60 performance of the Century, Buick's hot rod, has been chopped from 11.6 seconds to 10.8. The Special, at 11 seconds for the same acceleration, is improved by a full second and a half, the Super by .8 of a second and the Roadmaster by 1.2 seconds.

All the top speeds are higher, of course, with that of the Special at 110 miles an hour and the Century's at 116. That's an increase of five and four miles, respectively, if the police aren't looking.

The new Buicks are as much as three and a half inches down in height, which called for doing something extra to the torque-tube drive. The Buick superstructure, as everyone knows, rides on four coil springs. Most cars ride on coils in front and leaves in the rear. That allows a simplicity in transferring the rear wheels' thrust, which goes from the axle



SIMPLIFIED PANEL backgrounds depressed-center wheel. Panel top lifts off to service radio, wipers and wiring. Most knobs are recessed.



WINDSHIELD-WIPER CONTROL has been relocated on extreme left of dashboard at driver's side, as shown above. It has a built-in squirt button.

SET TOP SPEED DESIRED, with knob, in a little window at edge of speedometer face. A warning buzzer goes off if you exceed set speed.

to the rear springs to the frame. The drive shaft is simple, too, with a universal joint at each end to take care of angle changes. The system is called a Hotchkiss drive, after the inventor.

But you can't propel a car through coil springs. So with torque-tube drive the push from the wheels goes from the axle to a husky tube sheathing the drive shaft and thence to the rear of the transmission housing, the engine block and, finally, the frame—at the *front* end of the car.

Buick has always used a single universal, a front one, on its torque-tube drive, slanting the drive shaft and its enclosing sheath straight back to the differential. For 1957 this wouldn't work. When the roof line was lowered, the machinery had to be squashed down, too. That meant the drive shaft had to go down if its tunnel was not to stick up too far in the passenger compartment.

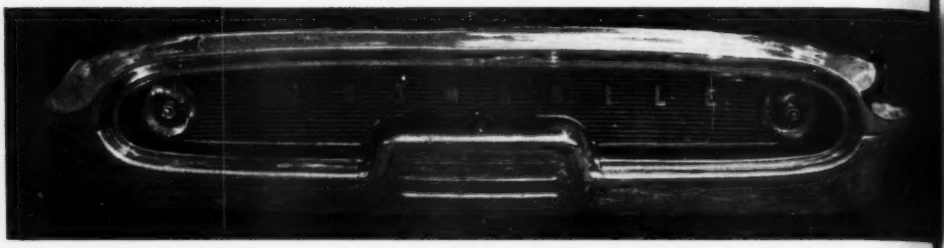
So Buick put a second universal in its drive shaft, toward the rear end. If you will look underneath, you'll see that the torque tube has a kink in it.

Buick always likes to put icing on the cake. This year's is in three flavors. The car's twin horns have new notes on the musical scale—"F" and "A" in place of the former "E flat" and "G." Softer and prettier, says the company. Then there's a new clock that—Buick says—is *always* on time. Regulates itself.

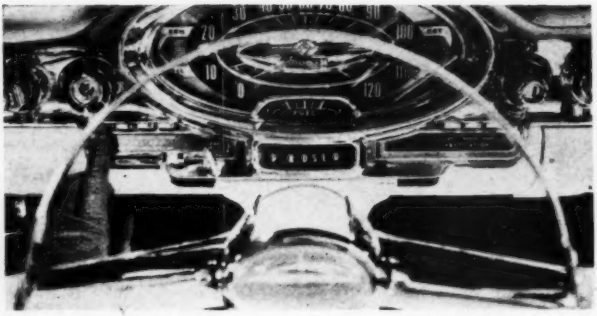
And finally, there's a dingus, developed by GM's AC Spark Plug division, that trips a buzzer if you exceed the speed you set into the speedometer by twirling a little knob. Keeps that accelerator foot from getting too heavy. END

Picture Tour of the '

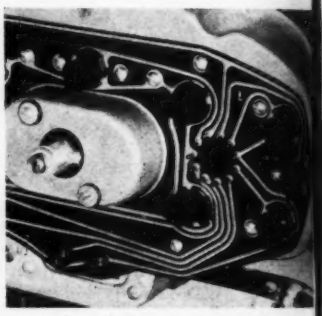
Last month, in the lower Michigan peninsula city of Lansing, the wraps came off the 1957 Oldsmobile. It's all new . . .



. . . from grille, flanked by . . .

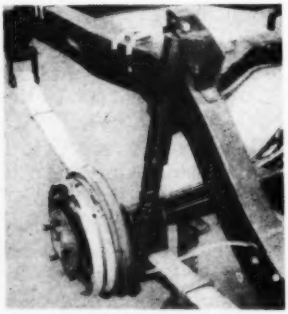


There are a lot of little surprises (such as push buttons for heat and ventilation) on a smart new panel behind a thin-rimmed steering wheel that has been deep-dished for safety . . .



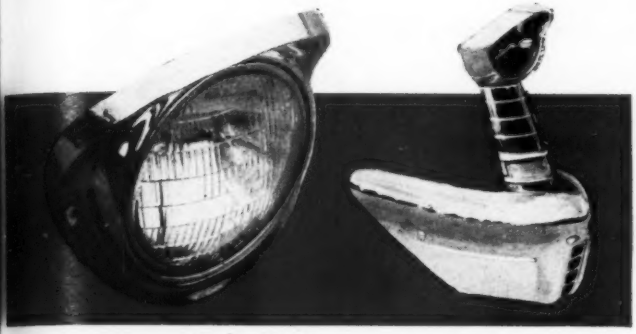
. . . printed electrical circuits, replace troublesome wiring . . .

The differential is more rugged to take care of a 400 foot/pound torque, and the Super 88's axle ratio was changed from 3.23:1 to 3.42.

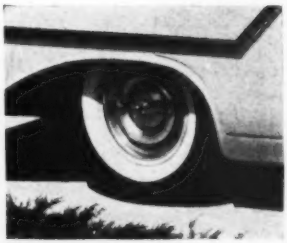


But the big change in the back end was moving the shocks outboard of the springs for better "wheel control" on bumps and less sway.

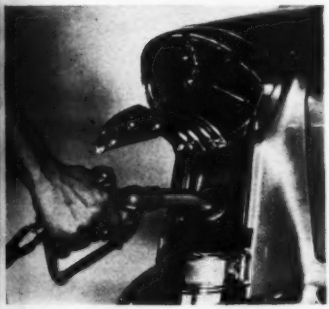
'57 Oldsmobile



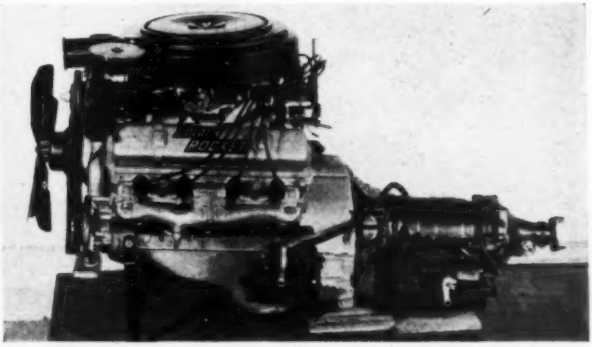
. . . visored headlights . . . to saucy rear trim.



Fourteen-inch wheels help lower the car's height 2.3 inches, to 58.2. The frame, eight inches wider, makes for lower floor. "Accent stripes" have contrasting color inserts.



. . . and a gasoline filler cap is relocated under a taillight.



There are a host of mechanical changes, starting with the engine, boosted in displacement, from 324 to 371 cubic inches (bigger than a Cadillac's!), and horsepower, from 240 to 277.

And here is the complete car—up to five inches longer, depending on the model—a lot more glass for visibility, and, all in all, with more changes than Olds has had in 20 years.

How Pontiac Lost

Shunning a mere "face lift" in his off-year model, Bunky Knudsen goes after a broader buyer group.

WHEN they rolled the 1957 Pontiacs on the salesroom floors for public viewing last month, something was missing. For more than two decades, bright, metal identifying strips running the length of the hood had proclaimed, "Yup, this is a Pontiac." The silver streaks, as the company called them, had become a hallmark, a talisman of sorts.

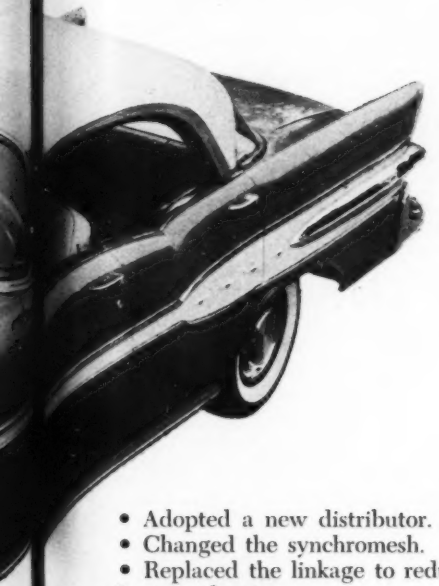
Now they were gone, and a man with a tart irreverence for tradition was responsible. He was Semon E. Knudsen, Pontiac's new general manager and vice-president of General Motors.

For energetic, black-thatched Bunky Knudsen, the operation on the streaks was only a warmup.

In a model year when Pontiac had been ticketed for only a "face lift"—a minimum of changes—Knudsen:

- Replaced all of the sheet metal except the roof.
- Lengthened the car.
- Beefed up the cylinder block.
- Altered the overhead valves to prevent oil seepage into the cylinders.
- Put on new manifolding.
- Redesigned the camshaft for an improved automatic transmission.

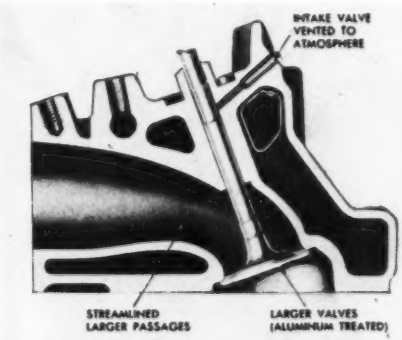
Its Stripes



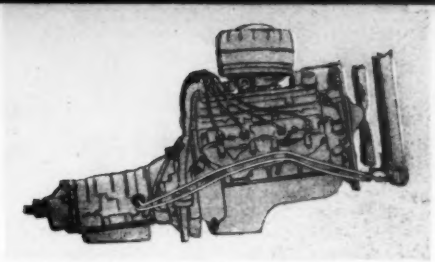
- Adopted a new distributor.
- Changed the synchromesh.
- Replaced the linkage to reduce accelerator vibration.
- Boosted displacement, compression ratio, horsepower and torque.

That wasn't all, by any means. The company lists 86 changes for 1957. Knudsen's renovation poses the question: What's *not* new in a face lift these days?

He intended it that way.



VENTING VALVE STEM to atmosphere prevents sucking vaporized oil from valve-chamber cover into cylinder under high vacuum of intake stroke. Pontiac claims a first for system.



TRANSMISSION OIL COOLER has been moved to the bottom of radiator from side of the transmission case for better heat dissipation. Pontiac's top horsepower for '57 is 270.

"The day of the mere face lift is gone," Bunky Knudsen says.

His opinions, like that on the removal of the silver streaks, are incisive.

"I want to reach a broader age group," he said, explaining the streak business. "You can sell older people a young car, but you can't sell young people an old one."

Knudsen could have had a tidy package of 300 horsepower in his car for '57. A Pontiac with exactly that under the hood was tested extensively.

"But you raise your horsepower," he said, "and blow your torque at the low end, where you want performance at the traffic light. Besides, how often do you drive 100 miles an hour?"

Knudsen was born into the automobile business. Son of the late William S. Knudsen—GM's grand old man, who was one-time production manager for the first Henry Ford, and President Roosevelt's director of production for the War Department—young Knudsen was taking cars apart before he reached his teens.

At 14, he was badgering his father for a car. One day William S., then Chevrolet's general manager, sent him over to the old Chevrolet plant on Detroit's Holbrook Avenue. The man in charge led him into a big room. On the floor was a new Chevrolet—in parts.

"They had even taken the springs off the frame," recalls Bunky.

Then the man handed him a note. "If you can put this together," his father had written, "you can have it."

It took him two months.

Knudsen had no compunctions about taking the silver streaks off the hood of the Pontiac. It was strictly a family affair. His dad had put them there. END

New German Luxury Liner Cruises Texas Highways

IF A 10-ton air conditioner, a spacious observation lounge, hi-fi, and free meals served in a stainless-steel snack bar can woo cross-country passengers back to riding the buses, the "Golden Eagle" will be well worth the $43,000 that Continental Trailways recently shelled out for it.

The first of a fleet of 50, this gold-plated, diesel-powered coach will travel between Dallas and Houston—245 miles. Although it was built by Karl Kassbohrer Co., of Ulm, Germany, Trailways is quick to point out that the plush, rest-room-equipped bus is really a composite of international engineering know-how. The lightweight tubular chassis and integrated body, and the 280-hp., turbocharged engine are German-made, the plumbing is British, and the rubber springing, hydraulic-leveling system and air-conditioning unit are American.

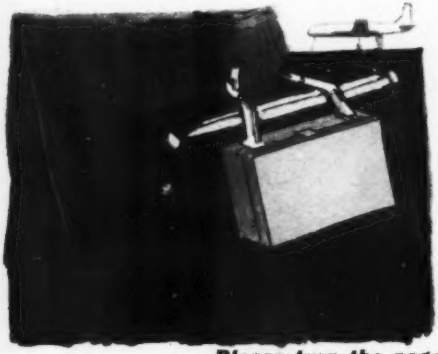
BIGGEST WRAP-AROUND WINDSHIELDS ever bedded in a bus front give the driver and passengers a picture-window view of the road ahead.

TABLES, PILLOWS, COFFEE AND COKES, not to mention meals served by a Trailways hostess, are all free, aboard the "Golden Eagle."

New Ideas from the Inventors

1 Dolly to Ease Engine Work. Supported by this platform "creeper," a mechanic could reach some parts of a modern car engine more easily with fewer acrobatics. A tray attached to the dolly would keep his tools within reach. The dolly could be wheeled into position and moved about easily on its castered base.

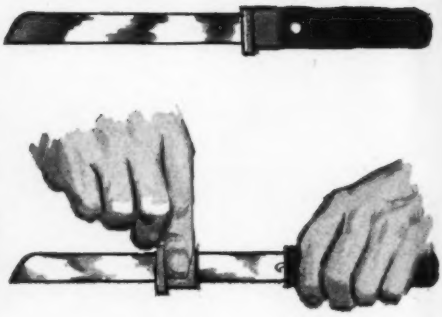
2 Suitcase to Hitch a Ride. This piggyback case would keep small travel articles handy. It could be carried separately, but when you wanted to simplify luggage handling, you could snap-fasten its strap to the handle of another suitcase as shown in the drawing below.



3 Squeezer to Tame Lemon Juice. Folded over a wedge of lemon, this disposable paper collar would let you squeeze the juice out without getting your fingers wet. Lapping over the sides of the slice, the paper would also block upward, face-spattering squirts.

Please turn the page for more new ideas

More New Ideas from the Inventors



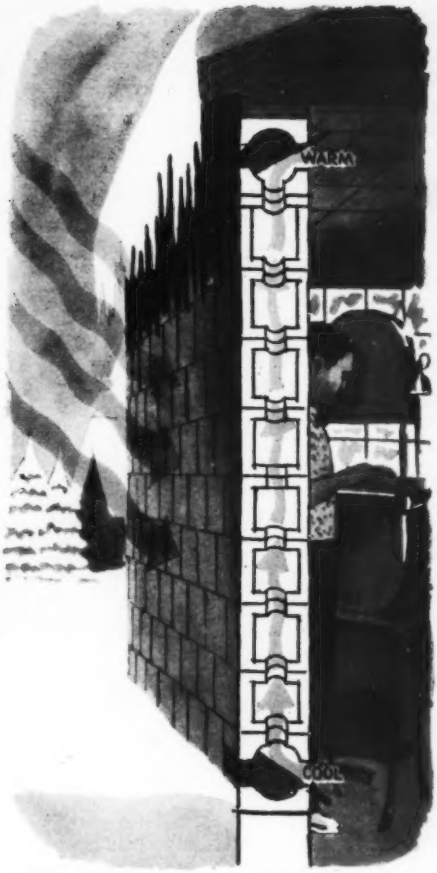
4 Hand Lever to Free Iced Wiper. With a pivoted lifter mechanism like this in your car, you wouldn't have to step outside to release an ice-bound windshield wiper. By jogging the arm manually in and out you could also dislodge snow or slush from a clogged blade.

5 Knife to Carry Own Sharpener. You could put a keen edge on the blade of this knife in a jiffy by sliding its little honing block back and forth a few times. When locked in place (as at top) by a spring catch, the sharpener would become a part of the handle.

7 Runway to Unstack Carts. Shopping wagons wouldn't pile up near checkout counters of a supermarket that had this automatic return. A trap door and ramp near each counter would feed empty carts onto a trackway in the basement. Inclined tracks and a lift conveyor would return them to the main floor.

6 Arm to Increase Brace Torque. Attached to the crank of a brace by a pin and wing-nut clamp, this extension bar would provide extra leverage for freeing stuck fasteners. It could be adapted to braces with wrench-type bits or those with standard auger chucks.

8 Rolling Shovel to Toss Snow. Aided by the wheels and leverage of this snow scoop, you could clear a walk or driveway quickly and easily. You'd move a "flip rod" in the handle to tilt the platform of the scoop, as in the drawing below, and throw a king-size shovelful of snow to one side.



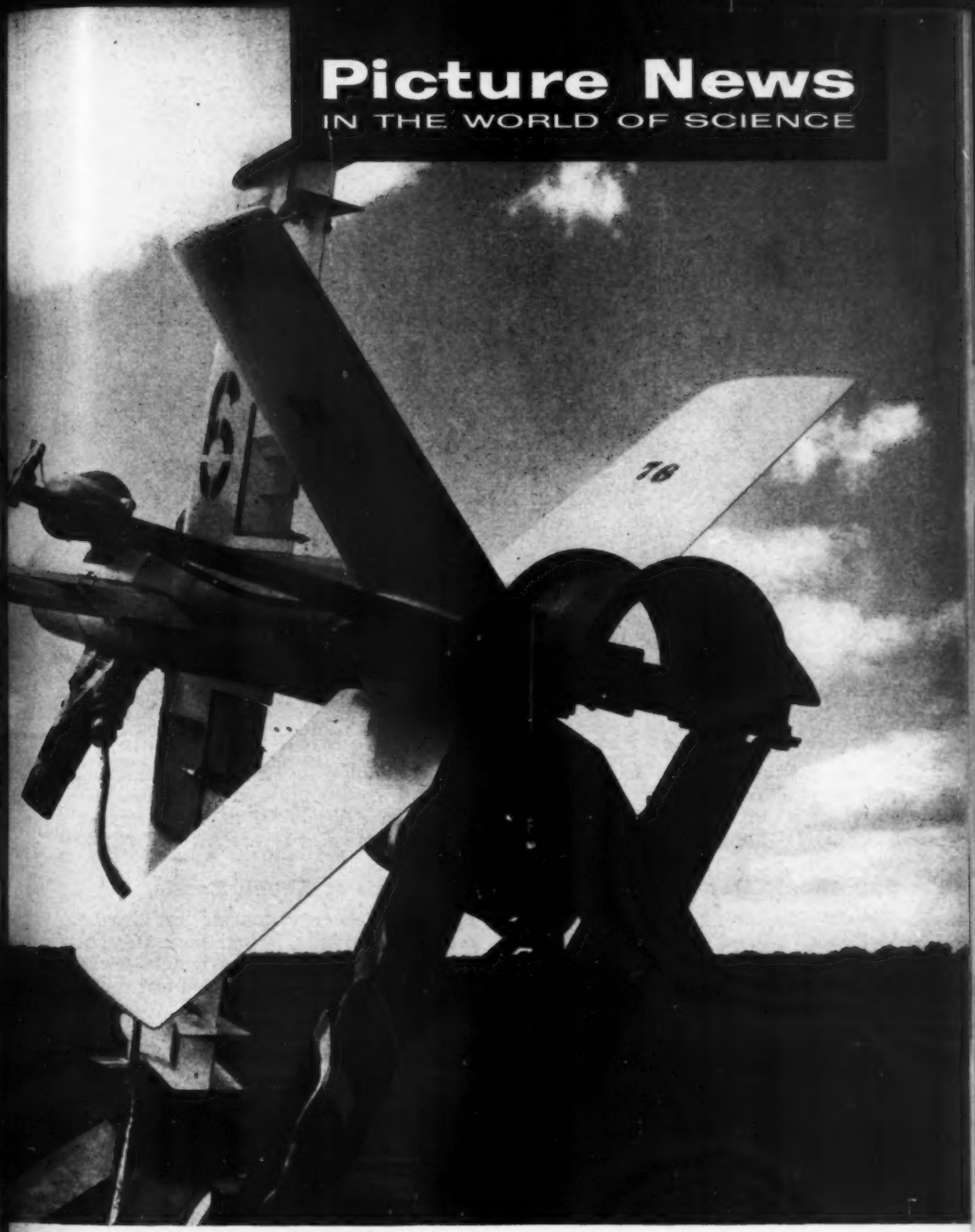
9 Vented Wall to Warm Building. Reversible valves at the top and bottom of a hollow-block wall might help to heat—or cool—a building. In winter, inside air (above) would circulate through the walls, rising as the sun heated it. In summer, with valves reversed, cool *outside* air, drawn in at the base of the house, would circulate through the walls.

The following patents *have been issued on these inventions: 1. Patent No. 2,701,168 to William J. Schemers, Detroit; 2. No. 2,707,035 to Sara H. Lashley, Atlantic City, N. J.; 3. No. 2,707,912 to Joseph G. Squarcio, Denver; 4. No. 2,717,408 to Alfred P. Le Page, Detroit; 5. No. 2,700,819 to Donald E. Mason, Greensboro, N. C.; 6. No. 2,705,898 to Allan C. Lazier, Los Angeles; 7. No. 2,743,827 to Peter Winokur and Edwin J. Ellis, Philadelphia; 8. No. 2,720,043 to Chester W. Chamberlin, Cleveland Heights, Ohio; 9. No. 2,706,442 to Douglas S. Risley, Miami.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C. at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

"Picture News in the World of Science," starting at right and running through page 138, brings together the month's hottest newsphoto bulletins in the world of science and technology. "Picture News" replaces the many pages of similar short items that were formerly scattered throughout the magazine. This big new regular feature is only one of many improvements you have noted recently in *Popular Science*. And still more are being planned for future issues. All are designed to make PS easier to read and more exciting to look at —without omitting a single thing that you have come to expect from your favorite magazine.

Picture News
IN THE WORLD OF SCIENCE



Glowing Taillight Guides New Antitank Rocket to Target

STEERED ON its course by remote control, the Dart, newest of the Army's tank killers, has the explosive power to destroy a heavily armored tank with a single hit. A fiery sodium flare, spewing in its tail, helps the missile-age cannoneer track the rocket to its goal.

Experimental Rover Powered by a Rear-Mounted Gas Turbine

THE gas-turbine auto moved a step nearer practicality with the English showing of this Rover T3. Its rear-mounted 110-hp. engine delivers zero-to-60 acceleration in 10.5 seconds and yet its fuel consumption of 14 miles per gallon at a steady 60 m.p.h. is modest for gas turbines. It has hit 102 m.p.h.

Supersonic Demon Jet Exhausts Fiery Trail of Shock Beads

WHEN the afterburner of the Navy's McDonnell F3H-2N Demon is "lighted off," a string of brilliant beads may appear in the air as the turbojet streaks faster than sound.

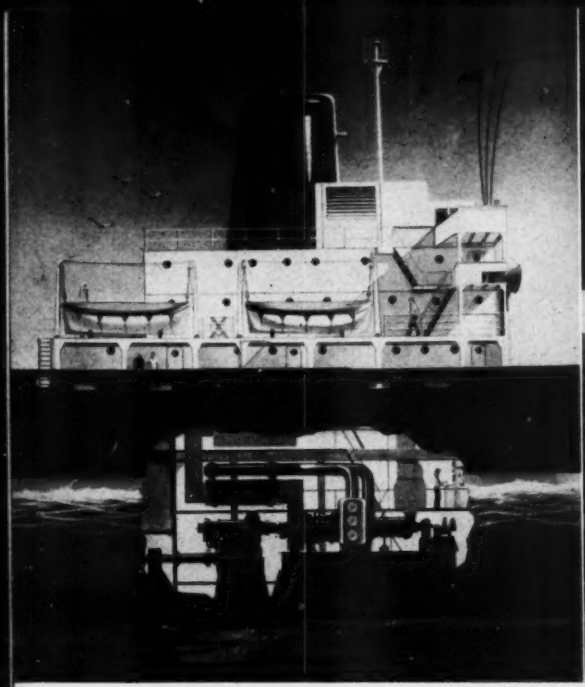
Here is what's happening: Supersonic exhaust waves, adjusting to the atmosphere, are reflected back and forth by the sound barrier like a ball bouncing between two walls. The original shocks alternately expand and compress until dissipated. The phenomenon, which is often seen on rocket exhausts, is visible under certain atmospheric conditions.

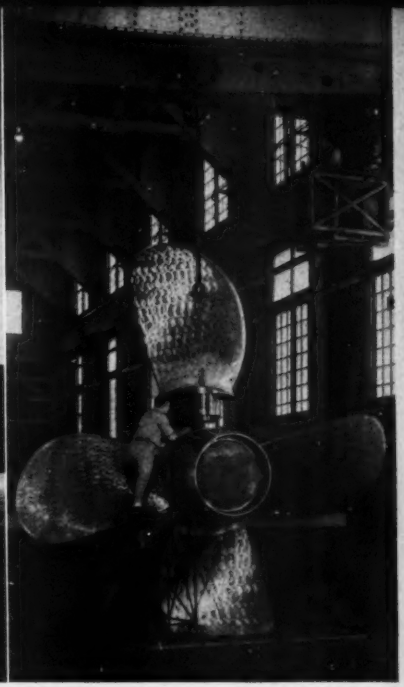
Compass Tester Gives the Works to Instruments Used in Planes

RESEMBLING some futuristic carnival ride, and acting in much the same way, this machine twists and turns like a plane to test sensitive aircraft compasses individually. While banking and pitching with the compass (black box at center), the General Electric device duplicates the strong magnetic pull of the earth.

1957 Thunderbird Has 270-Hp. Engine—Kit Will Take It Higher

FORD'S 1957 Thunderbird has a top-option 270-hp. engine (it was 225 in '56), and a racing-cam kit will push it to 285. The new Bird is 5½ inches longer, chiefly in its higher-deck trunk. A "memory" circuit slides its automatic seat forward to a selected driving position when the driver turns on the ignition.





New Engine and Propeller Take Liberty Ship Out of Moth Balls

A 6,000-hp., regenerative-cycle gas turbine, installed in the Liberty ship John Sergeant at left above, increased her speed from 10 to 18 knots.

Besides the General Electric turbine, biggest marine unit of its kind, the Sergeant has one of the world's largest controllable-pitch propellers (right), 17 feet six inches in diameter. It shifts, forward to astern, without engine reverse.

Part of an experiment on World War II "moth-ball fleet" ships, the reconversion may be the start of a program for a defense reserve of fast freighters.

Swedish Engineer Blows Iron Bubble—and He Lives in It, Too

THIS domelike house, built entirely of curved iron plates, may set a style in home construction in Sweden. Dreamed up by an engineer, Lars Engstroem, it provides comfortable living for him and his family. Interior light is supplied by clustered globes on the roof and large windows overlooking a nearby lake.

Poor Man's Rocket, and One Seven Times Faster than Sound

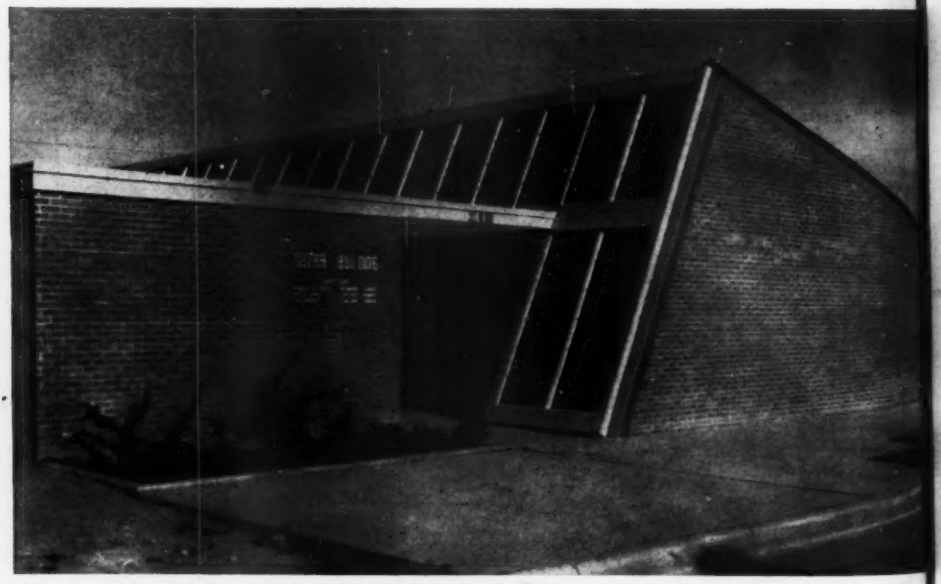
BILLED as a "budget" rocket, the little Terrapin taking off at left from a simple mount takes measurements of cosmic radiation 80 miles up. Three feet shorter than the 15-foot Terrapin, the Curtiss-Wright "hypersonic test vehicle" (right) gathers data at Mach 7 for the Air Research and Development Command. Republic Aviation built the "slower" Terrapin (Mach 5.8) for the U. of Maryland.

Russian Car Copies the Jeep

NEWEST version of the Red Squirrel (PS, Sept. '56, p. 142) puts a utility body on a short wheelbase for farm duty. With its 20-hp. rear engine spinning the small doughnut tires, the Russian jeep can skitter cross-country at 60 m.p.h., clearing the ground by only eight inches.

Paddle-Wheel Tugs Move Ships

THE old paddle-wheeler is turning up in the British Navy. Tugs with two paddle wheels, each 19 feet in diameter and chain-driven by its own 800-hp. diesel-electric power plant, are proving nimble at moving big ships around crowded dockyard basins.



Glassed-In Collector Wall Warms Building with Solar Heat

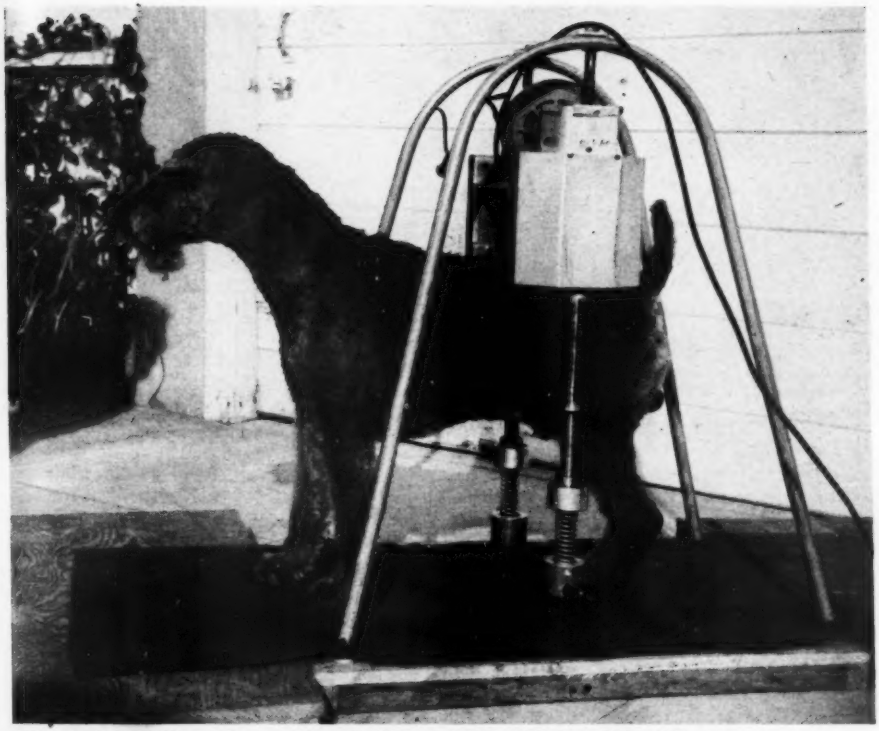
IN SUNNY Albuquerque, N. M., an engineering firm warms its offices with solar heat. Collector panels set up behind angled glass panes on the south side of the building hold water that is heated to 150 degrees and then pumped through radiant coils or stored in an underground tank for sunless days. The building is cooled by extracting heat from the water with a heat pump of the refrigeration type.

New Timing System Records Speed of Air Trophy Winner

Two new Bowen cameras at each end of the course timed Commander R. W. (Duke) Windsor in the Chance Vought F8U-1 Crusader above when he won this year's Thompson Trophy. He set a U. S. mark of 1,015.428 m.p.h. with the Navy entry. Each of the paired cameras, pointing straight up as at left, recorded the flight on a film strip moving behind a revolving shutter. It shot 30 negatives a second, exposing each 1/25,000 second.

Steel Pontoons Make Floating Roof for Huge Oil-Storage Pit

ABANDONED slate quarries at Windgap, Pa., are being used to store heating fuel oil. A roof for this pit, 225 feet deep and 56,000 square feet in area, was made from 240 hollow steel sections. The lid not only protects 42,000,000 gallons of oil from the elements, but the oval sign serves as an airway marker for the area.



Airedale Tidies Up on Do-It-Himself Brushing Machine

KEEPING well-groomed is fun for this California dog, whose master, Roy Latham, of Montebello, invented an automatic dog-brushing machine. As Jeep steps on a platform, his weight switches on a motor that spins three nylon brushes. Springs permit the top brush to conform to the animal's back as he goes through.

Big Aircraft Carrier Lowers Radar Masts to Pass Under Bridge

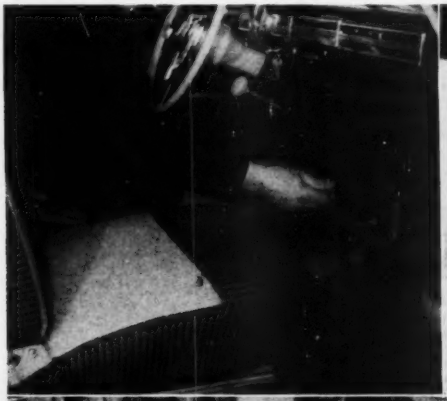
THE supercarrier Saratoga demonstrates the Navy's new hinged radar masts, which are seen here flopped over to clear New York's Manhattan Bridge as the 60,000-ton vessel heads out for her first sea trials. Formerly the masts had to be removed on other ships for passage under a bridge.

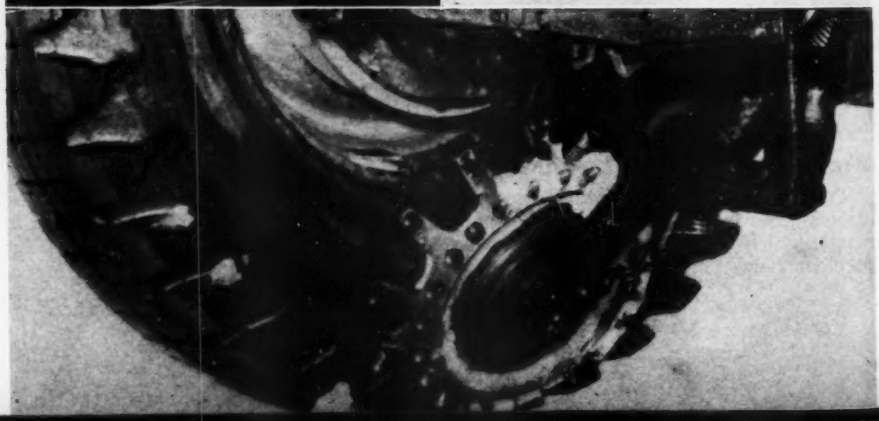
New Propellant Lets Jet Self-Starter Fire Up Without Smoke

THIS plane is not on fire. The engine at right is using a cartridge starter loaded with an ordinary propellant. The other engine of the Air Force B-57 tactical bomber was started at the same time, but with an improved "smokeless" fuel. The General Electric Turbostarter is for use where no ground power is available.

Teeth Grip in Ice or Snow to Make Winter Driving Safer

TOUGH Scandinavian winters led Richard Larsson of Sweden to invent a device with two toothed wheels, attached to the rear axle. When lowered by a hand lever in the car (below, left) they mesh with the sides of the tire tread (bottom photo) and take a firm bite into ice or snow. They're out of sight from the hub side.





Revolving Door Varies Speed for Slowpokes or Eager Beavers

A TWO-SPEED motor turns this revolving door at a constant no-hands three r.p.m. as the bundle-laden lady goes through. Pressure on a push bar shifts it to nine r.p.m. Still more pressure operates an over-riding clutch (diagrammed at bottom) for manual pushing of the International Steel Co. door up to 12 r.p.m.

Big Telescope Tracks and Photographs Missile 300 Miles Away

THIS ton-and-a-half revolving telescope can track high-altitude rockets as far as 300 miles. It has a 400-pound Fairchild lens system that automatically photographs jets, missiles and other flying objects. It is operated by direct or remote control, and was developed by the Army Signal Corps at Fort Monmouth, N.J.

Motorcycle Gearbox Drives This Tiny British Sports Car

THE fiber-glass Berkeley above can do 70 m.p.h., get 60 miles out of a gallon of gas, and stop on a sixpence. It weighs only 620 pounds. The little sports car is powered by a two-cylinder, 15-hp. engine with front-wheel drive through a three-speed motorcycle gearbox. It holds two comfortably in front, has a rumble.

Copter Carries Along Its Own Hangar in a Blow-Up Bundle

THE Sycamore need never be without a roof over its rotors. As the British helicopter lands (top photo) a 192-pound package is unloaded and spread out on the ground (center). An electric blower takes only five minutes to inflate 12-inch-diameter, built-in tubes, forming arches to support the fabric shed above.

Machine Tool Uses Electric Eye for Super-Accurate Measurement

THIS jig-boring machine has a built-in electric eye for spacing holes automatically and accurately to within 5/100,000 of an inch (about 1/40 the diameter of a human hair). GE technicians use it to turn out precision-drilled control parts for small gas-turbine engines being developed for Navy and Air Force planes.

Slow-Moving Rocket Launcher Tests Ship-Fired Missiles

A PLATFORM that simulates shipboard movement tests rockets at the Naval Ordnance Station at China Lake, Calif. The platform is a slow-moving cousin of the rocket-propelled sleds that test rocket launching at supersonic speeds.

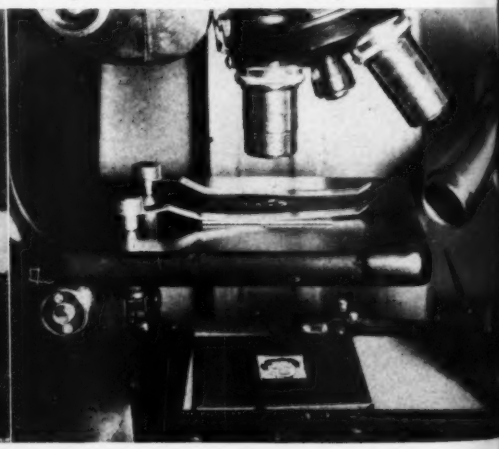
A streamlined railroad engine hauls a flatcar (far right) from which low-speed "crosswind" firings are made. The K-3 prime mover is unmanned on its run down the tracks and its freight is fired by remote control, usually with a third rail supplying the firing pulse. It can haul 4,000 pounds at speeds up to 50 knots (about 60 m.p.h.).

Boy Scouts Put World's Largest Air Marker on Mountainside

FLIERS 35 miles away can spot this air marker spelled out on the side of an Arizona mountain by Phoenix Boy Scouts of Air Explorer Squadron 13. The boys toiled weekends for five years with pick and shovel, crowbars and dynamite to cut a bed for the 100-foot-high crushed stone letters. The "I" is 12½ feet wide.

Science Takes a Picture Through the Eye of a Grasshopper

THIS is how things look to a grasshopper. Mississippi State College scientists mounted the insect's eye on the microscope stage at right below and, as a stunt, shot a photo through it. The multiple images are what the grasshopper at left below might see, unless its brain interprets the images less dizzily.



New Aids to Living

1 Electric hairbrush gives hair and scalp a vigorous workout with moving bristles that make 5,000 push-pull strokes a minute. The bristle head lifts off from the motor housing to make cleaning easy.

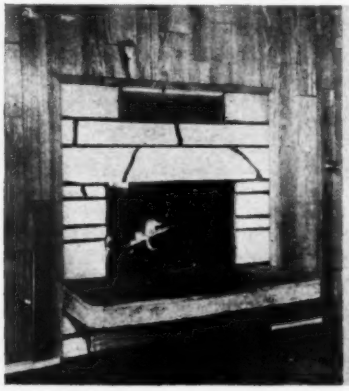
2 High-water rubbers of thin, unlined neoprene slip over broad work shoes (or your bulkiest brogans) without a tussle. The high tops will catch messy or dangerous on-the-job splashes.

3 Slide-viewing kit has a 12-inch screen in the lid of its case. The projector can also be beamed at a wall to blow up two-inch slides or 35-mm. film strip to three-foot-square size for group viewing.

More information *about the products shown on this page can be obtained from: 1. Cory Corporation, 3200 W. Peterson Ave., Chicago 45; 2. Tingley Rubber Corp., 903 Ross St., Rahway, N. J.; 3. The Buttafarri Corp., 207 Fourth Ave., NYC; 4. The Falk Co., 1219 California St., Denver 4, Colo.; 5. Superior Fireplace Co., 601 North Point Rd., Baltimore 6, Md.*

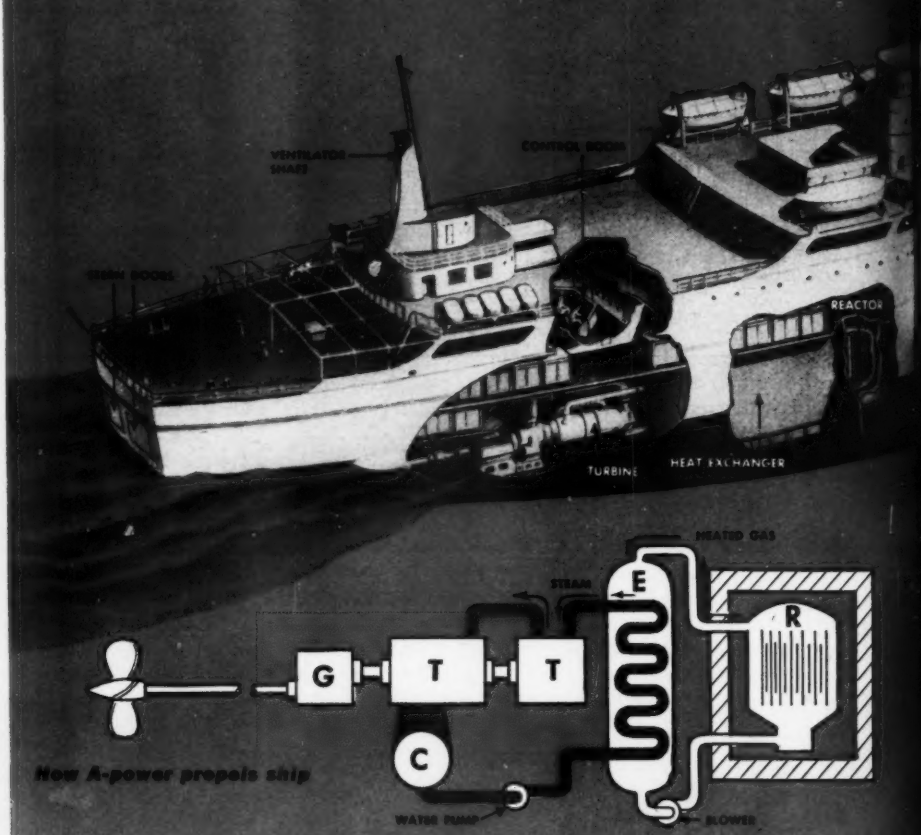
4 Sack sealer closes wax, plastic or cellophane bags tightly to keep bread, potato chips and other foods fresh. A rod snaps into a tube open along one side, and the bag is clasped tightly between them.

5 A two-faced fireplace that puts a hearth in two rooms can be built with this prefabbed core. Cool-air inlets are set into the brickwork below the firebox on both sides of the opening. Heated air travels up side ducts in the metal form and flows out of a pair of grilled outlets to make both rooms cosy. The smoke goes up a single flue. A grate is used to nest the firewood and keep it centered on the hearth.



Atomic Freighter

An artist visualizes a design for a 600-foot cargo vessel propelled by nuclear power



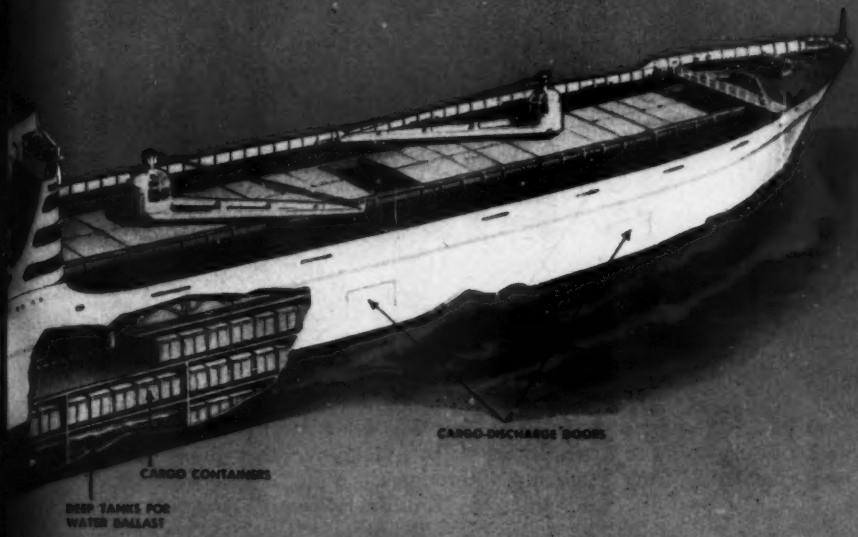
How A-power propels ship

REACTOR (R) HEAT converts water in heat exchanger (E) to steam, which drives turbines (T). Condenser (C) reconverts steam to water. Turbines turn gearing (G) to drive props.

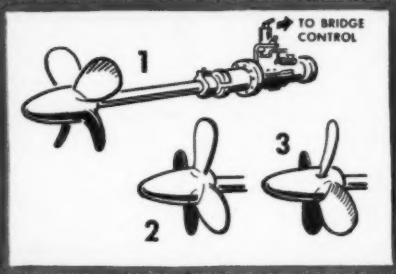
PLANS for atomic-propelled merchant ships are on the drawing boards in England, as in America. Here is an artist's conception of a proposed British design for a 600-foot cargo vessel, of 16,000 to 18,000 tons' carrying capacity, to run on nuclear power.

Heavily shielded amidships, an atomic reactor delivers hot gas to the freighter's boilers, which make steam to run geared turbines driving the main propellers. As an alternative, gas turbines and a secondary hot-gas circuit could replace the steam system.

Planned in England

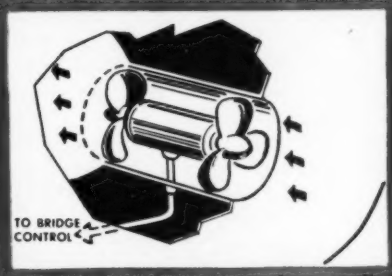


Screws have variable pitch



PROPELLERS, hydraulically controlled from bridge, can change pitch. Diagram above shows: (1) astern; (2) neutral; (3) ahead.

Auxiliary propellers, at bow, aid in maneuvering



REVERSIBLE BOW PROPELLERS, also controlled from bridge, fit in tube running athwartships. Watertight motor in tube runs them.

Innovations in the vessel's design include a transverse tunnel, below the waterline near the bow, fitted with reversible auxiliary propellers to aid in maneuvering and docking. Lower decks carry freight in easily handled containers, which are designed to fit into railroad cars as well; and electric cranes stow general cargo above.

The artist's drawing is from the *Hunting Group Review*, the London publication of a worldwide group of companies whose list is headed by the British shipping firm of Hunting & Son Ltd.

Gus Fixes an Eggbeater

By Martin Bunn

GUS WILSON'S service truck was having heavy going of it over the mountain road to Highland. Snowplows had opened the road after an early winter storm, but now—a week before Christmas—a new fall of snow was coming down thickly. The weather was bitter cold.

The burly proprietor of the Model Garage had pulled up and stepped from the truck to remove a large branch from the road, when he heard the sputtering of an airborne motor.

Wiping the snow from his face, Gus caught a glimpse of a helicopter flying low over the trees across a deep ravine to his right. The awkward-looking machine seemed to be in trouble. As Gus watched, the engine ran raggedly and the rotor blades slowed. The helicopter staggered in the air, slid sideways and dropped into the forest. An exclamation of horror escaped Gus's lips as he dashed down into the ravine.

Gus found himself floundering in deep snow. By the time he had reached the bottom of the ravine and started to climb the other side, he was gasping for breath. Gaining the top, he found that there was still no sign of the downed helicopter.

Then, suddenly, the silence was broken by the outraged bellowing of a voice that Gus knew well.

"By yimminy, this thing goes, or through the snow I walk to Highland."

"Knute Hansen!" Gus exclaimed. "What in time is that old coot doing up here in a helicopter?"

Gus moved toward the voice and came to a little clearing, where the stricken ship squatted in the snow. Ralph Erickson, a Helicopter Incorporated pilot, and Knute Hansen were walking about, apparently uninjured.

"Hello there," Gus called out. "Is anybody hurt?"

ERICKSON spun about. "Well, I'll be darned if it isn't Gus Wilson. What are you doing here?"

"I was on a service call to Highland," Gus told him, "when I saw you go down. My truck's over there on the road."

Knute Hansen's pale blue eyes lit up with relief. "I don't worry no more now. Gus Vilson fix this whirlybird so she flies to Highland to fetch out my Frieda's kiddie."

"Frieda's kiddie!" Gus breathed. "You mean that one of your daughter's children is . . ."

"It's little Inga," Knute said. "She's—"

"She's got appendicitis," Erickson inter-

As Gus watched, the engine ran raggedly, the helicopter staggered in the air and slid sideways.

rupted. "We got a call to evacuate her to the hospital in a hurry. Then this blasted rig began to cut out and we plunked down in the snow."

"Appendicitis!" Gus turned swiftly away and gestured toward the mountain road. "Come on—we'll go on to Highland in my truck."

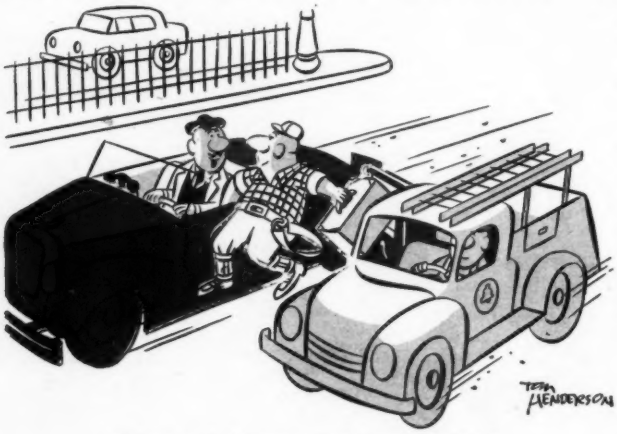
"You can't get through," Erickson said flatly. "The state police told us that the road to Highland was closed by snow and fallen timber a little way above here. It'll take days to clear it."

"I didn't know," Gus said, and his glance went quickly to Knute Hansen.

Knute, a widower, lived in town, but his heart was never far from his daughter and her family in Highland. A picture flashed through Gus's mind of a Christmas Eve, when he had been a guest in Frieda's home, seeing six-year-old Inga cuddled in her grandfather's arms, the old fellow stroking her yellow hair, his eyes soft.

"We've got to get through," Gus declared grimly, "and fast. What's wrong with this rig, Erickson?"

"It'll take a copter mechanic," Erickson said harshly. "The average mechanic can't touch this thing. And all I know is how to fly them."



"Why, yes, I did report my phone out of order."

Gus walked over to the helicopter. Looking at the complicated, unfamiliar pile of machinery, he felt a sinking in the pit of his stomach. Normally, he thought, an automobile mechanic would have no right to tamper with this thing, and then tell a man to get in and fly it. With tools produced by Erickson he removed the front cowling plate to expose the six-cylinder, vertically opposed engine.

"She was missing badly when you came down," Gus said. "Sounded like ignition trouble. Maybe you've got fouled breaker points or it could be a shorted ignition wire."

Locating the magnetos, Gus went to work to check them and trace the unfamiliar wiring, looking for loose connections or broken insulation. Finding nothing wrong here, he began checking generally, not knowing exactly what it was that he was looking for. Perhaps an iced gas line.

"Plenty of gas?" he asked Erickson.

"Sure—I filled up before I left. I'm always careful about that. You see, this ship uses 91/96 aviation gas. Our other one uses 87/88."

"Then this ship uses gas with a lot more lead in it than the other one?"

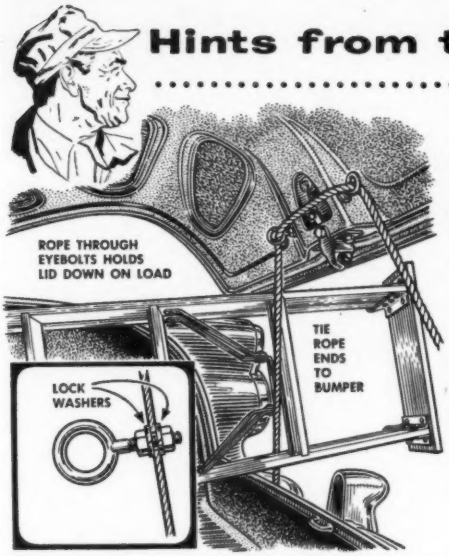
"Eight times as much," Erickson said.

"We'd better check the plugs," Gus told him. "They might have developed lead fouling."

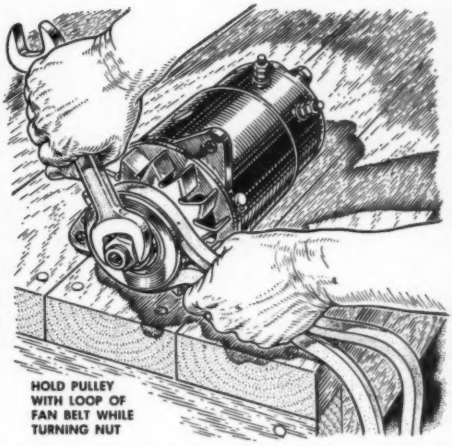
GUS removed the plugs, his fingers numb with cold. Some of them, the lower ones particularly, had a heavy gathering of lead fouling on the electrodes. A thorough cleaning would require a sand blaster, but he did the best he could with his knife.

[*Continued on page 208*]

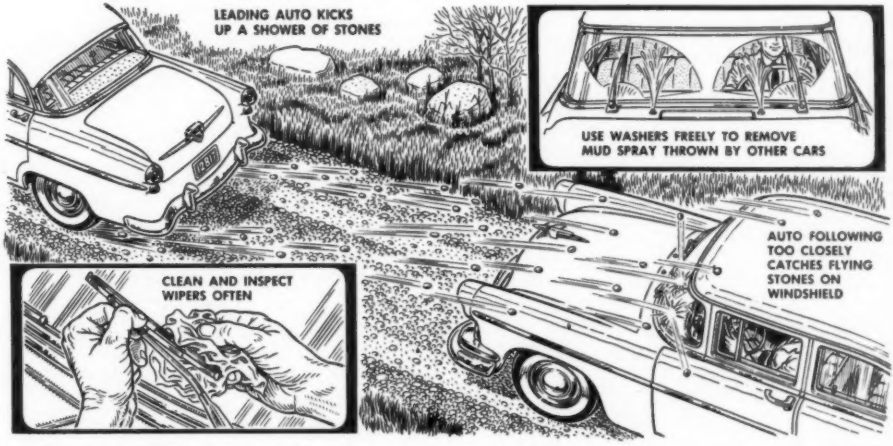
Hints from the Model Garage



Tie the car trunk lid down on loads that hang over, by threading a rope through two eyebolts installed on the inner frame of the lid. Drill holes to fit the bolts and lock them in place with double nuts. Tie the rope to the bumper.



To remove a generator pulley without damaging it, loop the fan belt around the groove and grip it firmly while you loosen the nut. If the nut is stubborn, use an old fan belt and lock it in a vise to get a tighter grip on the pulley.



Modern windshields are expensive. Here are three ways to safeguard yours:

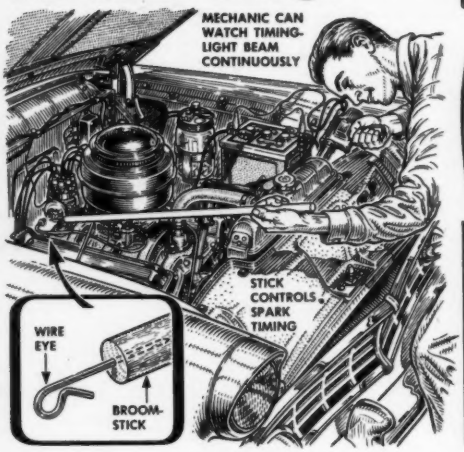
Use your windshield washer to flush dirty road spray thrown up by other cars, and use wipers briefly. Glass is hard, but grit particles are even harder.

Keep your distance when following another car on an unimproved road. The other fellow's tires may hurl stones or sand, marking or fracturing your glass.

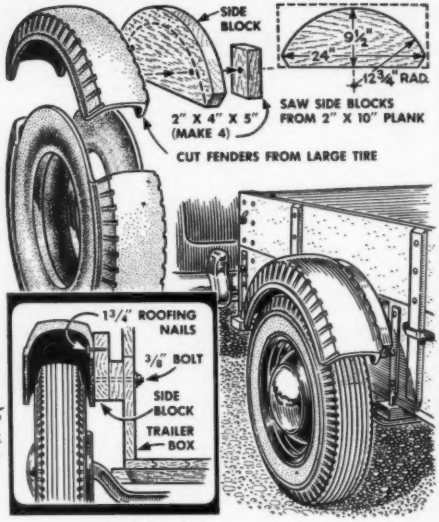
Clean wiper blades often, see that they make contact and have not hardened.

Please turn the page for more auto hints

More Hints from the Model Garage

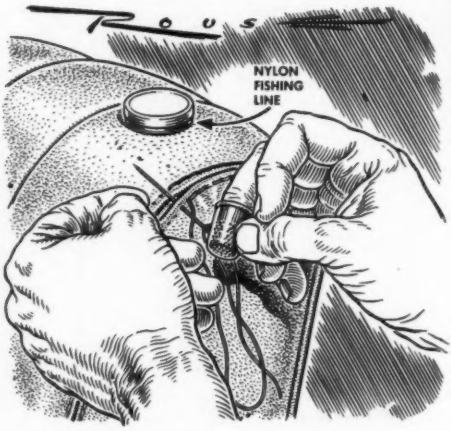


When timing an engine that has the distributor at one end and timing mark at the other, use a stick with a wire eye pressed in it to rotate the distributor body while you beam the timing light on the mark. Disconnect the vacuum line for accurate timing and slip the eye over the fitting on the diaphragm housing.



Make your own trailer fenders to keep the wheels from throwing mud all over your car. Cut segments from a truck tire (7.50 x 17 is a good size) and nail them to blocks bolted to the trailer sides. Use blocks thick enough to position the fenders over the wheels, and set the fenders high enough to allow for spring action.

Don't let a "wise guy" push your car ahead into a fireplug area or no-parking zone to make room for his car. Turn your wheels toward the curb when near such a spot and then you'll be sure to find your car right where you left it.



Stitch open seams in slip covers or car upholstery with nylon fishing line. It comes in several colors, and line rated at 12 to 15 lb. test is hard to break. An upholsterer's needle will make stitching seams on flat surfaces easier.

MECHANICS and HOMEBUILDING

It's a job you can do!

Installing Modern Switches and Outlets

By Darrell Huff

CORD CAN'T PULL OUT of new locking-type outlet (left). This is just one of many improvements you can make by replacing old single-purpose switches (below) with modern units.

YOU can do a lot to modernize your electrical system from a wall box. These small metal boxes contain the switches and outlets that put your system to work. Replace these old units with modern ones, and you have—within the limits of existing wiring—a new system.

The boxes are easy to get at. After turning off the electricity, you remove the cover plate with a screwdriver. You touch only the wires that are already exposed inside the receptacle box. You unhook these wires from the old switch or outlet, rehook them to the new one, and put the cover plate back on. That's all there is to it.

It's a job anyone can do. Modern switches and outlets fit the same wall boxes in the same way as the old ones. By putting in new units, you can have switches that turn on or off noiselessly, light up or glow in the dark, respond to the touch of an elbow when your hands are full, or turn off the

lights after you've had time to get into bed. You can have outlets that turn on at a switch, lock plugs in their sockets, or keep children from poking in dangerous bits of metal.

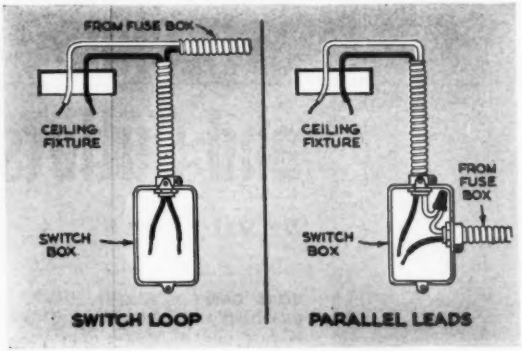
New combination units also make your wall boxes do double duty. If you need extra outlets—and most homes usually do—you may be able to get them by converting single-purpose wall switches to new switch-plus-outlet combinations. You still have the switch, but then you have an outlet, too.

With the same type of combination, you can convert an ordinary outlet to a switch-controlled one, so that you can operate kitchen appliances without plugging and unplugging them all the time.

That extra outlet. If you have a wall switch that has power available—if both sides of the circuit pass through the receptacle box—you can incorporate a valuable bonus—a convenience outlet. Switch-high outlets are more convenient for many uses than baseboard outlets.

To find out whether you can add an outlet to a switch, turn off the electricity (by pulling the main switch or branch

How to tell if you can add an outlet



You can add an outlet to a wall switch if four wires enter the box (near left), but not if only two wires enter the box (far left).

If you have four wires, disconnect the two black ones from the old switch and wire them to the new switch-outlet as shown at right. Remove the solderless connector from the two white wires and twist on a third short wire. Replace the connector and attach this single short wire to the second terminal on the outlet.

You can put in a new switch in just a few minutes

TAKE OUT SCREWS that hold the cover plate. Replacement method is the same for an ancient push-button switch like this as newer toggle. *Be sure to turn off the electricity first.*

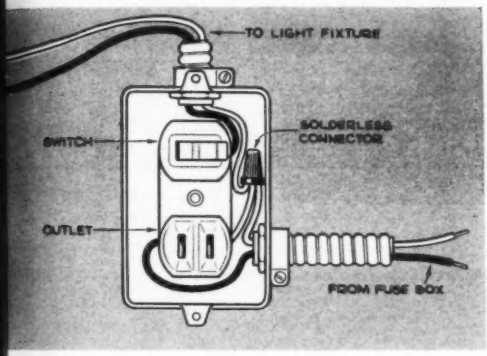
DETACH THE SWITCH by removing the two screws that hold it in its recessed wall box. Switch can then be pulled out a few inches so that you can get at the wire connections.

LOOSEN TERMINAL SCREWS and unhook the two electric wires. The contact posts on this switch are reached from the front; on other types you'll find them on the sides or in the back.

fuse), then remove the cover plate and the two screws that hold the switch in its box. Lift the switch out a little and see if two or four wires enter the box.

If there are only two, you are looking at the insides of a switch loop (see drawing on page 148). Actually the two wires are a single lead from the power line, cut so that the switch can be inserted in series. You can replace this switch with any other switch, but you *cannot* add an outlet because you have only one side of the circuit, the hot side, passing through the switch box.

...and how to wire it



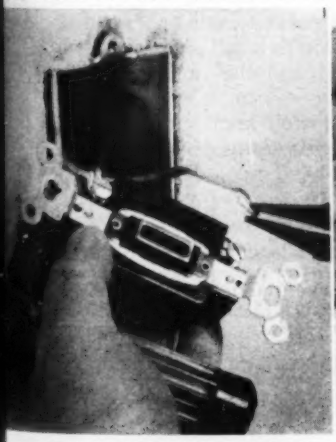
Don't ever try to use the metallic cable covering (or the ground wire in nonmetallic cable) as the other side of the circuit. This is not designed to carry prolonged current loads and has a high electrical resistance. If wired into a circuit it may become hot and start a fire *without even blowing the fuse.*

However, if you find four wires entering the box (usually two two-wire cables), you can replace the old switch with a switch-outlet combination. You can install the combination so that the new switch controls the same fixture as the old switch did and the new outlet is permanently "on."

If you want to get fancy you can get a combination that has two switches and an outlet (it fits the standard receptacle box). Then you can use one switch for the overhead lights and the other to control a lamp or appliance plugged into the outlet.

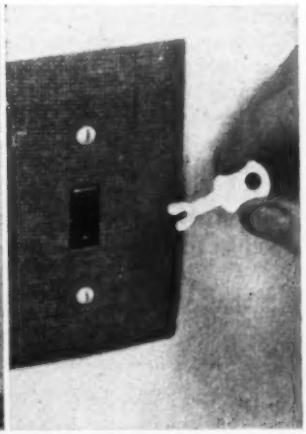
Remember, though, that adding outlets does not increase the current-handling capacity of your circuit, which remains the same as it was.

A combination switch-outlet can also be used in any box that now has only an outlet, for instance to control kitchen



CONNECT NEW SWITCH by hooking ends of wires clockwise around binding posts and tightening screws. Black wire goes to the brass binding post, the white wire to the nickel one.

FOLD WIRES BACK, push switch into box, and replace holding screws. Note that screw holes are elongated—they allow you to set the switch straight even if the box is slightly crooked.



REPLACE COVER PLATE. This one is a new decorative type made of vinyl-clad metal. The switch is a standard toggle, with one important difference—it can be turned on only with a key.

Here are some of the modern switches and outlets you can add

appliances. This will work even if you find only two wires at an outlet box, as at the end of a circuit.

Making "pigtails." In some cases, you may find it necessary to connect two wires to the same terminal, as in hooking up some types of switch-outlet combinations. Direct connection of more than one wire to the same terminal screw is not permitted by electrical code.

Look for a second terminal screw connected to the first one by a metal strip, and fasten your second wire to this. If no second terminal exists, twist the two wires together, plus a third short wire called a "pigtail." This should be of the same gauge as the others (usually No. 12). If in doubt, snip a short end off an old wire and take it to the hardware store.

Carefully solder the three wires together and tape them, or use a solderless screw-on connector. Then fasten the pigtail to the terminal screw.

Incidentally, when you replace outlets that may be used for heavy appliances or power tools, put in the new three-hole grounded sockets that take the new three-prong appliance plugs. These are made so that the third contact is automatically grounded to the receptacle box when you screw in the outlet. You can still use your old two-prong plugs in the new outlets.

Silent switches that shine. New switches don't make the noise that the older types do. There is a new rotary switch with a silent twist knob instead of a toggle lever, as well as a quiet mechanical toggle and the noiseless mercury type.

The rotary-switch knob glows in the dark. Some toggle switches—mechanical and mercury—have neon lamps in the

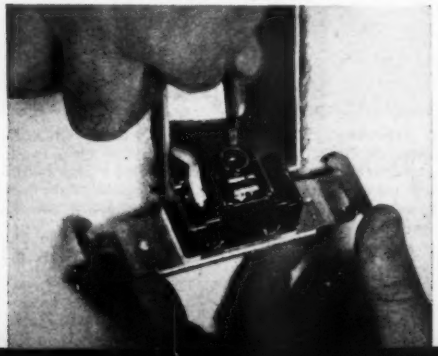
SWITCH-OUTLET combination supplies power and controls the room lights, too. This type locks the plug in the socket when you twist it.

ROTARY SWITCHES, installed in place of ordinary toggles, give your walls a modern touch. This Roto-Glo has a luminous knob.

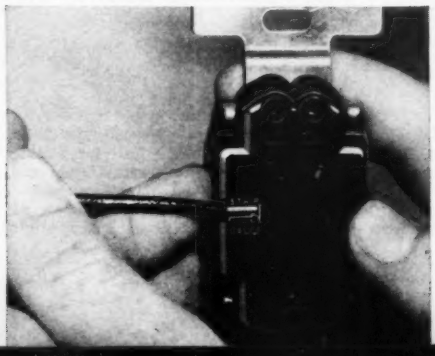
More information *about some special switches can be obtained from the manufacturers below. Other products mentioned are available at hardware stores and mail-order houses. Delayed-action switch: A-1 Electrical Supplies Co., 3910 S.E. 82nd St., Portland, Ore.; Luxtrol light dimmer: Superior Electric Co., 385 Laurel St., Bristol, Conn.; Roto-Glo switch: Pass & Seymour, Inc., 100 Boyd Ave., Syracuse 9, N. Y.; Tap-Lite switch: Minneapolis-Honeywell Regulator Co., 2954 4th Ave., Minneapolis 8, Minn.*

New spring terminals make it easy to connect wires

PRESSURE-LOCK TERMINALS are available on a wide variety of switches, outlets and combinations. To connect them, you just press the wires into holes without tightening screws.



GAUGE SHOWS HOW MUCH WIRE you need to strip for a pressure-lock terminal. To disconnect a wire, you just insert the tip of a screwdriver into a slot beside each terminal hole.



ILLUMINATED WALL PLATE glows in the dark when switch is off. Plate is wired to switch, makes contact through overhead light. When switch is on, plate shorts out and overhead light goes on.

GOT YOUR HANDS FULL? It's still easy to control room lights with a touch switch. One push turns them on, another push and they are off. This Tap-Lite switch is silent and has a transparent cover plate that takes wall-matching, or contrasting, inserts.

toggles. The latter serve as reverse pilot lights. If the light is off, it tells you at a glance that a switch has been left on. If you prefer a more positive indication, then you'll go for the opposite type of pilot-light switch—one that glows when the juice is on.

Switches that lock. If you want to make sure that no one can tamper with a switch, replace it with one of the locking type. Essentially this is a toggle switch except that the toggle is made in the form of a removable key.

With another type, you can be like the fellow in the old joke who was so fast he could flip a switch and hop into bed befor the light went out. This delayed-action switch turns on exactly like an ordinary switch, but takes its time when you press it to "off."

Shockless outlets. Children can't poke scissors into special shockproof receptacles. These are designed so that nothing but a proper plug can make electrical contact. Another safety device is a replacement cover plate that bars the way to hairpins, scissors, and toys.

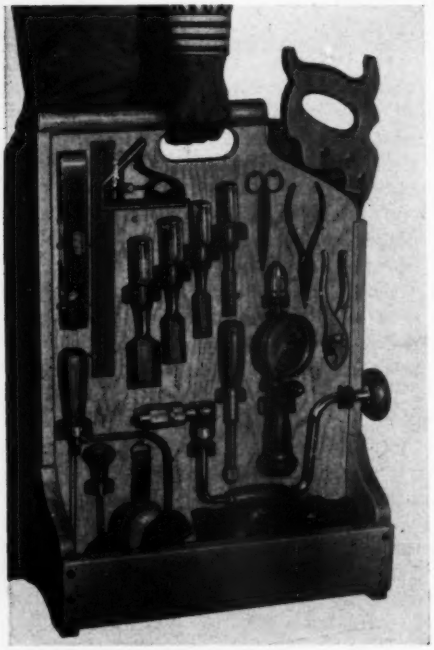
Another nuisance is the old receptacle that won't grasp a plug and hold it. The remedy is a twist-lock outlet. When you push a plug into this, it holds with conventional tightness. But if you twist the plug, the prongs lock so you can't pull the plug free—convenient for appliances whose power cords may be subject to accidental tugs.

TV light dimmer. The king of all the light-switch replacements is a dimmer that changes the brightness of room lights by regulating the voltage. Called Luxtrol, it requires no rewiring, but does call for a special, larger wall box. END

New for the Handyman

1. Two Paints Do Unusual Jobs. An anti-electrolyzing ingredient in the gutter paint at right lets you use it on new galvanized gutters without vinegar or copper sulfate "etching" to prevent peeling. It will also stick to aluminum without undercoating.

With a pale, clear varnish and new tube colorants (above) you can now mix varnish in 24 interior wood tones and modern tints. Two ounces color a gallon.



2. Carrier Also Displays Tools. This helper holds tools within easy reach and sight like a tool board, but you can carry it like a toolbox. Hang tools on both sides of its plywood panel with the hooks and clips furnished. A built-in scabbard takes a handsaw. Two bins below hold miscellaneous items. The carrier comes already built, or in a prefab kit.

More information *about these products can be obtained from: 1. (gutter paint), Rust-Oleum Corp., 2799 Oakton St., Evanston, Ill.; (varnish stain), Pittsburgh Plate Glass Co., 632 Ft. Duquesne Blvd., Pittsburgh 22; 2. Yield House, North Conway, N. H.; 3. Jack Buelow, 748 Sandhurst Drive, St. Paul, Minn.*

3. Single Tool Does Glazing Job. Slide this trimmer along a window frame to cut out old putty with one blade; then with another pass you can embed new glazier points. Slide it in the third position (below) to trim the new putty.

Why struggle with a star drill to make a hole in concrete? You can rent a modern shooting tool, and then—

Blow That Stud Down!

By Jerry Parker

YOU make just a mild pop with a stud driver, not a big bang. But you do get a big thrill the first time you fire this explosive-actuated tool and see how easy it makes the tough job of anchoring metal or wood to concrete.

Suppose you have to fasten some two-by-four sills to a basement slab. Try driving in cement nails? Bore slow holes to China with a star drill? The very thought makes you sweat.

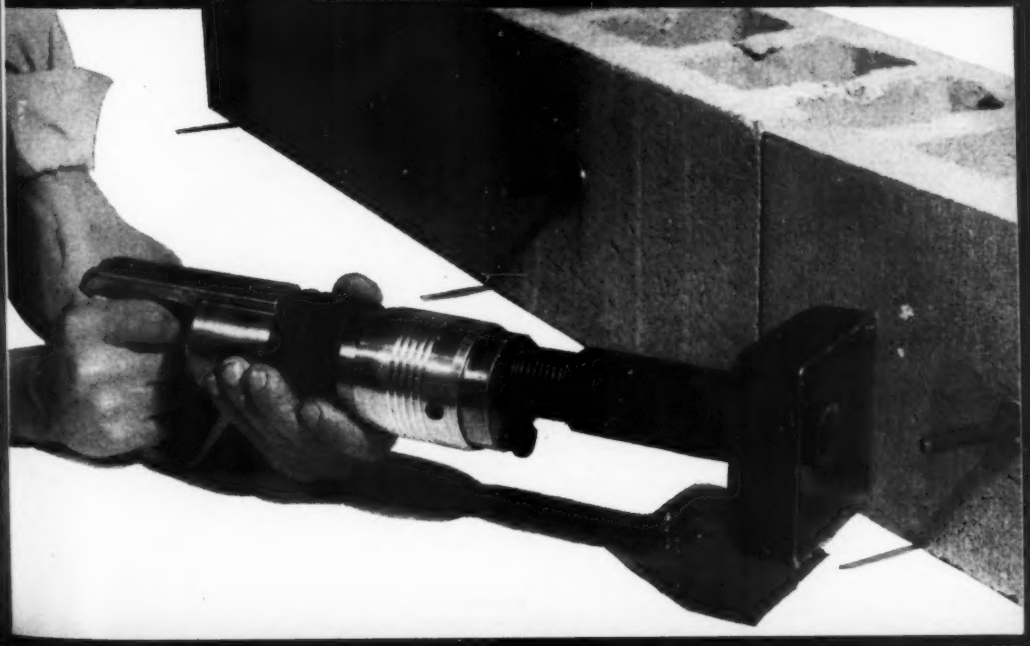
Now suppose you could just slide a tool along the two-by-four, pull a trigger, and whack it down as fast as firing a

Drop in the stud

Slip in the shell

Lock the breech

Press—and fire!



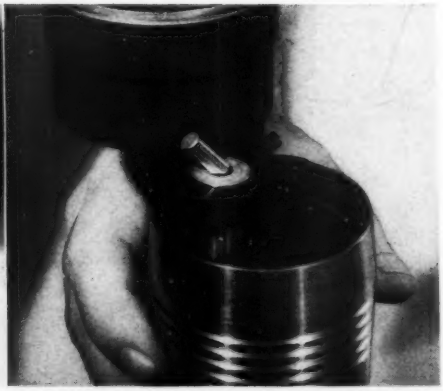
Here's a baby stud driver for the home shop

SMALL HAND-FIRED DRIVER is a cinch to use, yet does most jobs of bigger tools. To load, you unscrew cap and drop in stud. This Remington "Mighty Mite" sells for less than $35.

NEXT YOU DROP IN CARTRIDGE CHAMBER and slip a shell into it. Driver uses special .22-caliber blank cartridges and can fire a choice of 25 different ¼" studs for all types of jobs.

rifle. With a stud driver, you can. In fact, that's just what it is—a gun. You load it with a special rim-fire blank cartridge. Its bullets are ¼" or ⅜" alloy-steel fastening studs. When you pull the trigger, the blast sinks the stud deep into concrete or mild steel.

Once in, the stud is in to stay. It takes from one to five tons to dislodge it on a straight-out pull. In shear—with the pull



EMPTY SHELLS ARE EJECTED either manually or automatically. On the small driver above, you remove the cartridge-holding chamber and run it down over a metal finger on the guard to push the fired shell out. On the big drivers, such as the one at right above, the shell is flipped out by a bolt-like action when you break open the gun to reload it.

GUN CAN'T FIRE until you screw cap back on and twist and press down hard against the work. This pushes firing pin up through top of cap, but retracts it automatically if you let go.

DRIVER HAS NO TRIGGER, so you shoot by tapping firing pin lightly. Hold the gun firmly straight down, not at arm's length, so a heavy blast can't twist a wrist or spatter chips.

at right angles to the stud—it takes several tons more. If you put up a shop shelf with 10 studs, it could theoretically support an 80-ton railroad passenger car (actually, the concrete would give first).

It's fast, too. A stud driver isn't exactly a machine gun, but a good hand at it can shoot six studs a minute. Imagine the speed of putting up long rows of furring strips for a basement paneling job. Or shooting big sheets of plywood right against a concrete wall.

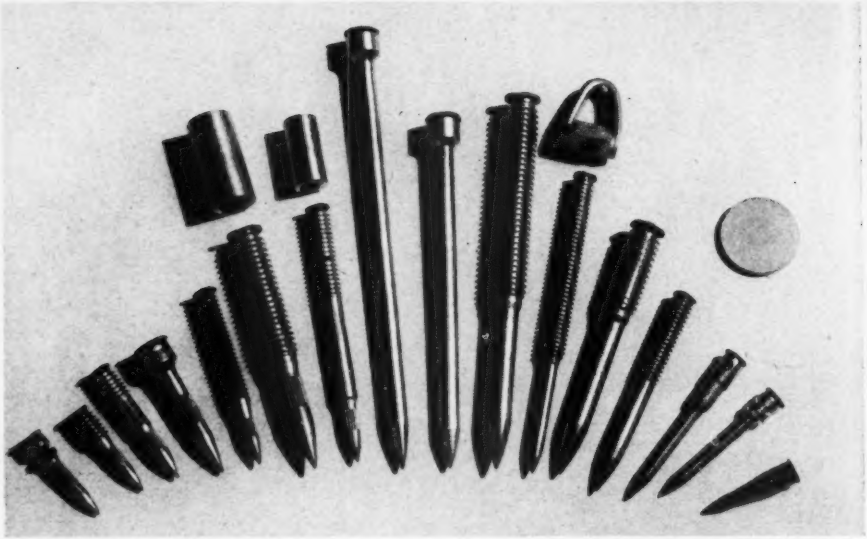
You can rent a driver. The big, professional guns, like the one shown on page 153, cost from $140 to $170. It wouldn't pay you to spend this for occasional around-the-house jobs, but now you can usually rent one whenever you need it. Many tool-renting agencies, lumberyards and hardware stores rent drivers for about $3 a day.

If you'd like to own a driver, there's also a baby model now available, Remington's "Mighty Mite," that sells for less than $35. It does all the jobs of its bigger brothers except that it uses the smaller ¼″ studs, which are—let me tell you—plenty powerful for any home chore.

A stud for every need. Along with the driver, you get a choice of some 40 different kinds of fasteners. Some look like nails and are used in the same way except that the gun—not you—hammers them in. They'll "nail" wood up to 3″ thick to concrete, brick or steel.

For bolting things up, there are studs whose ends are threaded, either on the inside for inserting standard machine screws, or on the outside to take nuts, couplings, and pre-threaded fixtures. Special eye heads let you connect cables, guy wires or antennas quickly. Break-off heads let you drive the stud, then knock off the end for a semi-flush fit.

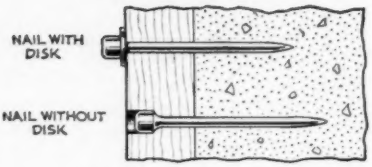
Look at the jobs you can do. You don't even have to aim—the guard that fits over the gun's muzzle does it for you. The standard one is a square, boxlike



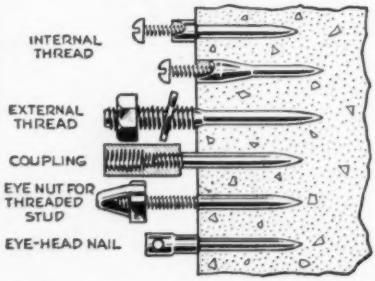
YOU CAN FIND A STUD FOR ANY JOB from 40 different kinds. Long "nails" above attach wood. Threaded studs take standard nuts, couplings (upper left) or special eye nuts (upper right). When you shoot through metal disk at right, it controls depth, keeps heads from pulling through, and prevents cracking. Sketch at left below shows how some of the fasteners are used.

HOW STUDS DO DIFFERENT JOBS

Anchoring Wood to Concrete



Anchors for Fixtures in Concrete



housing that centers the muzzle so that you can position the stud by lining up guide marks on the guard with guide marks on the work. In tight spots, there's an off-center pivot that lets you swing the muzzle to either side of the guard so that you can work in close.

For special jobs, there are nearly as many interchangeable guards as there are studs. The one for putting down two-by-fours is a U shape that exactly straddles the wood and lines up the gun for a perfect shot each time. You just slide it along and press the trigger as fast as you can reload and fire.

Want to put up an electrical box in the cellar? There's a slotted guard for this that fits right over the box and holds it for you while you nail it in. Or perhaps you'd like a row of outlets over a workbench. Another guard whacks up metal raceway in minutes.

Anchoring pipe or conduit to concrete becomes a snap with a recessed guard that fits over the pipe and staples in clips to hold it up. It can be adjusted for ½", ¾" or 1" pipe. Other guards fit angle and channel iron, put up strap hangers for

heating ducts, even staple down carpet grippers for concrete floors.

It's a gun—but safe. For all its power, a stud driver has more safety gadgets on it than your son's .22. It can't fire unless the breech is securely closed and locked. It can't fire unless the muzzle guard is pressed tightly against the work. It can't fire even if you're set to shoot, then change your mind—the second you relax your grip the spring-mounted muzzle guard retracts the firing pin, automatically uncocking the gun. The guard itself is designed to box in the blast and protect you against flying chips, although goggles are recommended.

To load up, you drop a stud into the gun, point down, very much like a bullet in a rifle. The cartridge is slipped into a separate chamber above the stud. All parts are out of alignment and can't fire until the breech is closed. When you pull the trigger, the firing pin explodes the cartridge that blows the stud home.

The fired stud bores its own hole, then gets its tremendous grip from the concrete or steel that has been pushed aside. The used shell is kicked out by a bolt-like action when you break open the gun to reload.

About the only hazard is using a driver on the wrong material or with too heavy a charge. Never fire into wood alone, plaster, thin metal or other soft objects—the stud will go clean through. Even on a concrete-block wall, a stud that hits a hollow spot with too much power is likely to disappear inside the block.

Remember that a driver is designed to blow studs into concrete, heavy-gauge mild steel (¼" thick or more) and certain kinds of masonry—that's all. Even with a solid backing, you risk shattering if you try to fire into hard tool steel, tile, glass, stone and similar brittle materials.

The manufacturers also warn against shooting too close to the edge of a concrete wall or floor—the edge is likely to shatter off. A personal test of this proved how very right they are.

How to use the driver. There are five grades of charges (light to heavy) for

[*Continued on page 218*]

You Can Build

A Three-Purpose Nursery Unit

It's a Stepstool

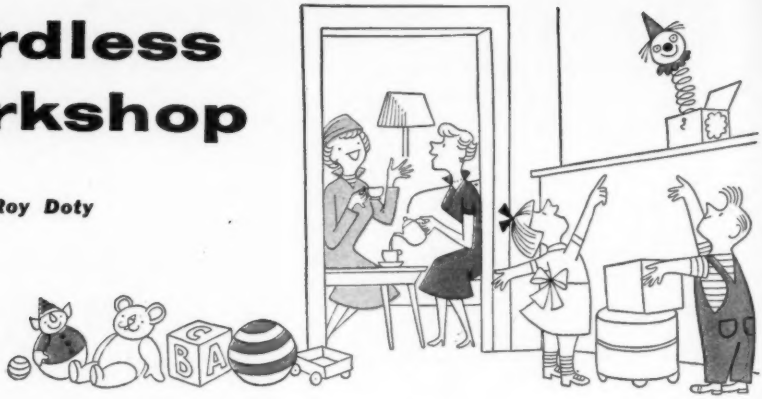
It's a Chair

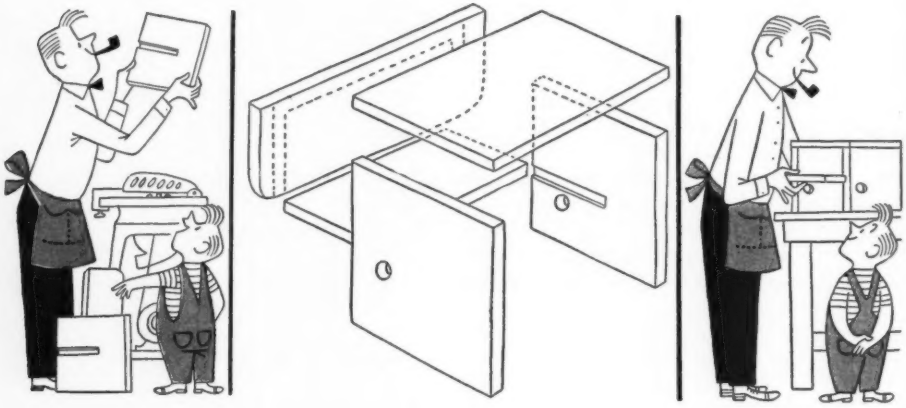
For how to build it, turn the page

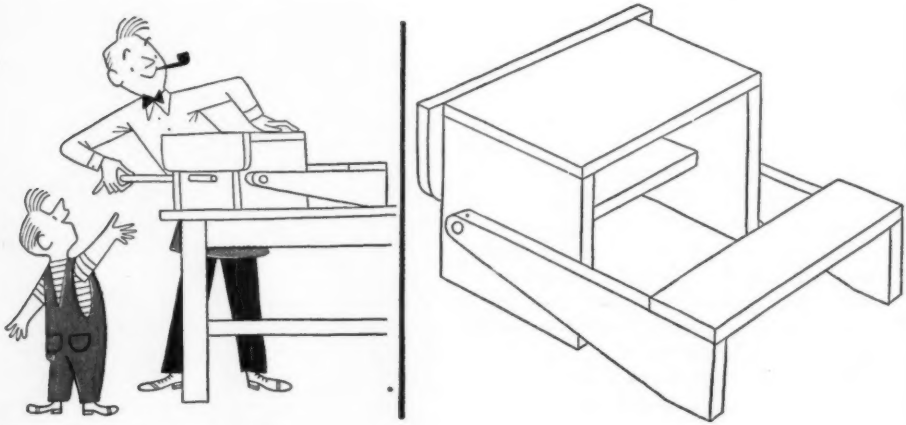
It's a Desk

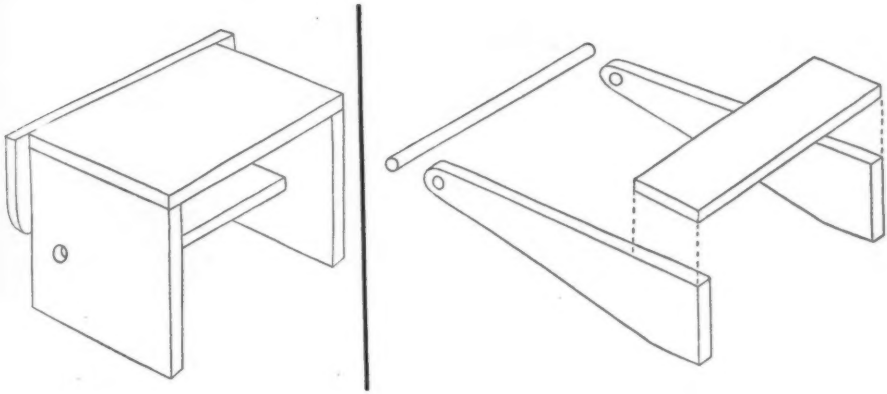
Wordless Workshop

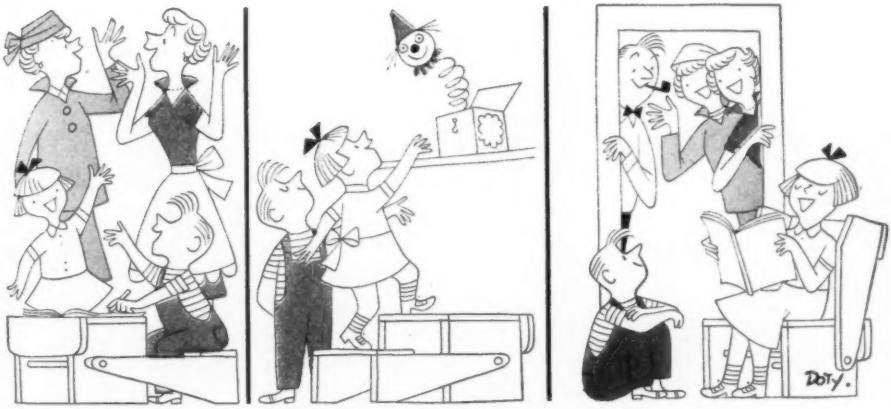
By Roy Doty



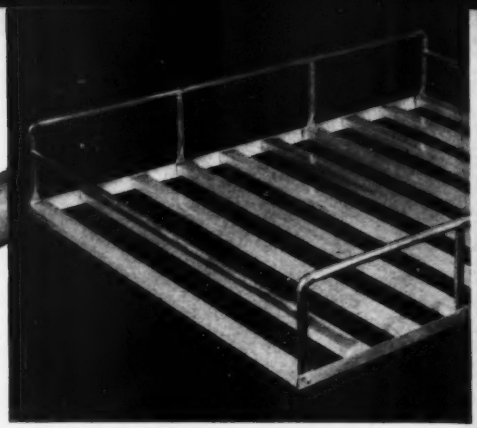








Next Month: A toy bucking bronco that bounces on springs



NEAT CORNERS for projects such as railings, furniture and the auto luggage rack at right are made with the 90° elbow fitting shown at left. Each end has a slotted spring washer that's spread to a snug fit before the tubing is slipped on. The tubing is then twisted to further tighten the washer to a lock fit. Tubing for the rack was flattened at the lower ends and bolted to the aluminum angle frame.

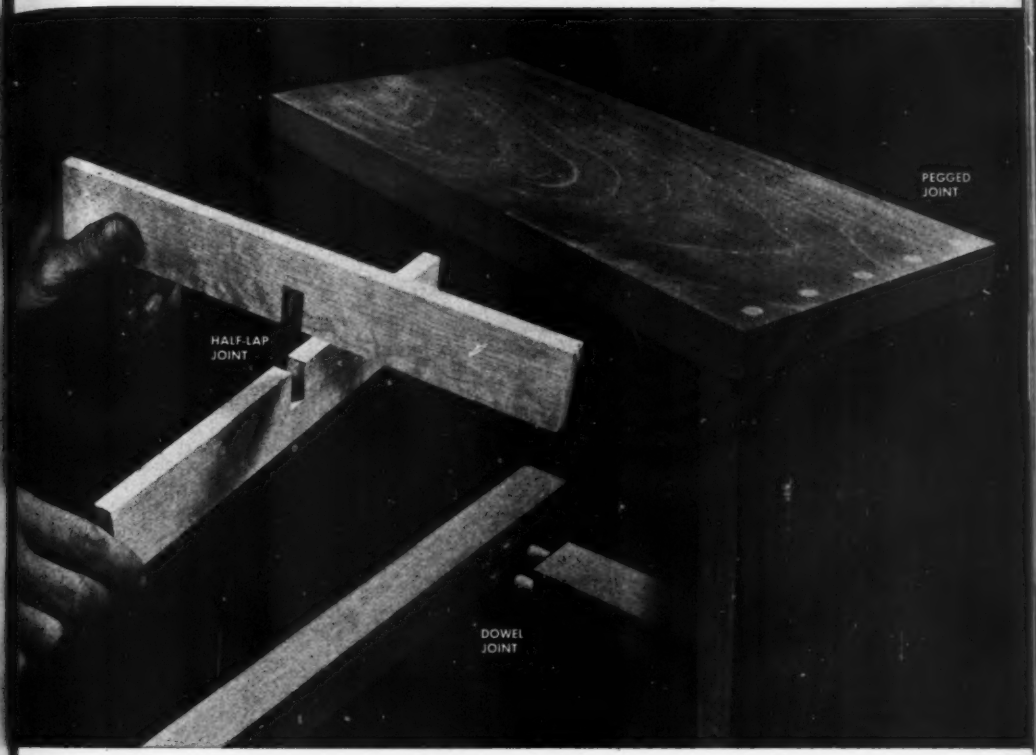
Joining Aluminum Tubing Is Easier Now

EVER try to join the end of aluminum tubing to the side of another piece? Now you can do it quickly with a special connector, one of three new fittings that make it easy to assemble hardware-store aluminum tubing.

Sharp turns are made by inserting a 90° elbow. To fasten tubing to walls, floors or the underside of tables, you use a flange fitting.

Made of matching aluminum, the connectors are slipped into the tubing and locked invisibly by spring washers that expand against the inside. They are made by Reynolds Metals to match its ¾″, 1″ and 1¼″ aluminum tubing.

T-BUTT CONNECTOR joins tubing at right angles for strong cross-bracing, as in table below. At left, the connector serves as its own jig for drilling hole in tubing, for bolt that will hold it in place. Tubing to form stem of tee is then slipped over the connector and locked by tightening the bolt. Aluminum snap-in caps finish off ends of the tubing, as shown below.



Now the Easier Wood Joints Are Strong, Too

There's no reason to struggle with dovetails when dowels, half-laps or even butt joints may do your job just as well.

By R. J. De Cristoforo

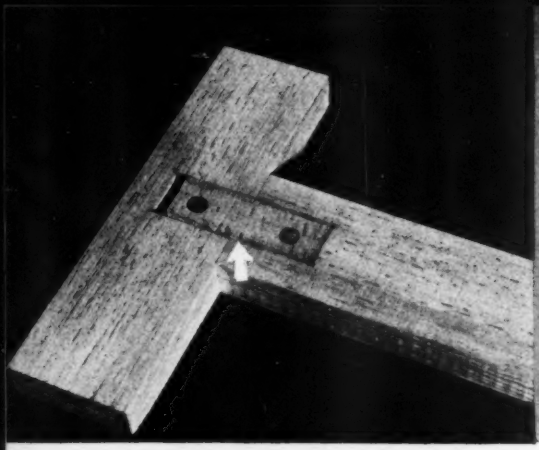
THE complex wood joints the old-timers used aren't needed any more. Even the lowly butt joint can be a good joint today. Modern adhesives that form bonds stronger than the wood itself make the difference. To you this means faster woodworking. You can do a good job with less effort.

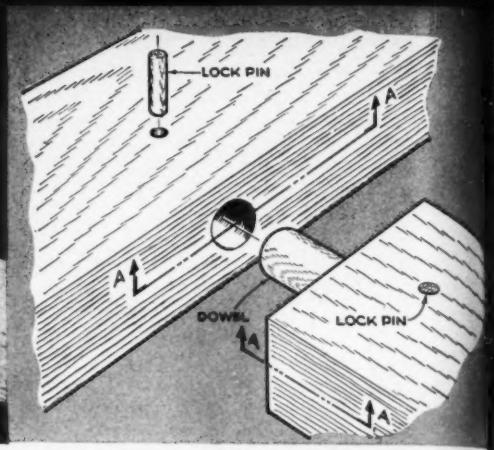
The not-so-handy can share the satisfactions of woodworking, too. New materials in panel form eliminate the fussy joinery of making big boards out of little ones. All that's left are simple structural joints—the simpler, the better.

Even the tougher joints are simpler today because of the wide use of power tools. Ones like those above and on the following pages represent some of the easier ways that you can put wood together. You don't have to worry about a couple of hundred joints when a dozen

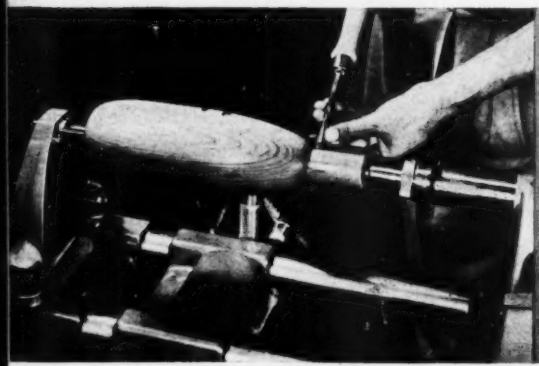
[*Text continued on page 164*]

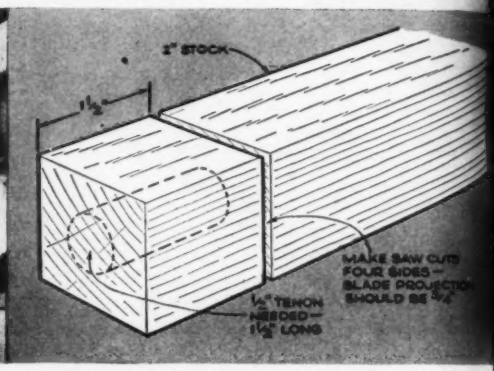
For pictures of various types of joints, turn the page





LOCKED DOWEL JOINT. In this, cross pins and a modern adhesive produce an assembly that should never give way. The photo above shows an inside view of a locked dowel joint. This was produced by sawing an actual joint along lines a-a above. Arrow indicates main dowel.

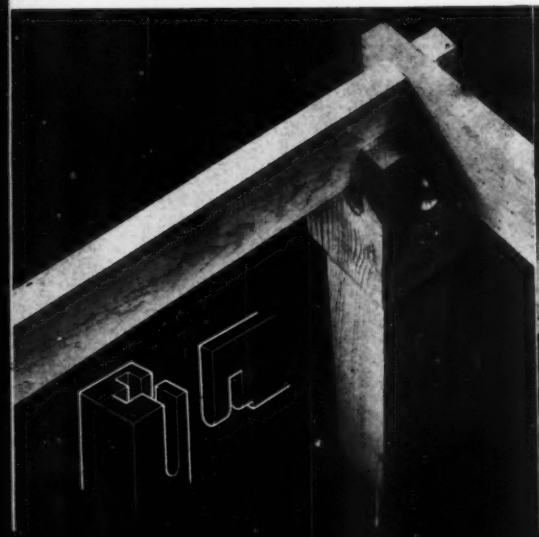


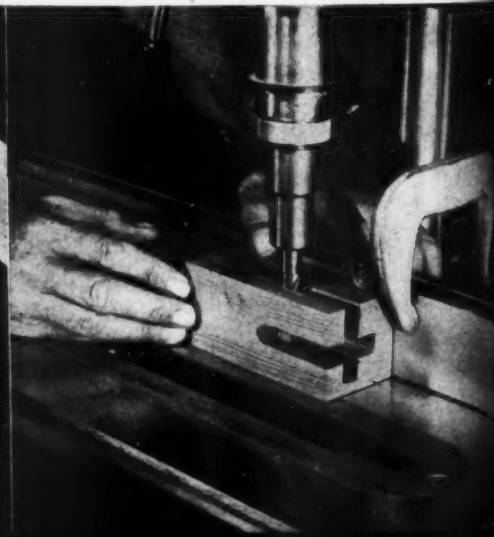


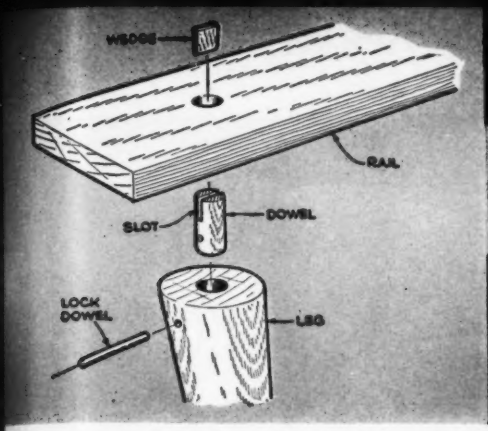
AN INTEGRAL DOWEL turned as an extension of a leg or other turning makes a stronger joint than separate dowel. Pin or wedge it in place.

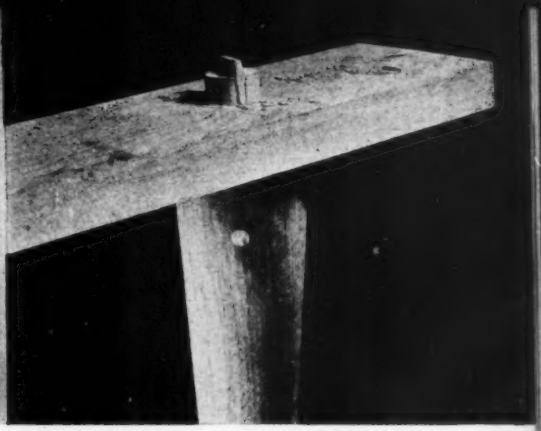
AN INTEGRAL DOWEL ON SQUARE STOCK can be formed without a lathe, as seen above and on the facing page. A plug cutter mounted in a bit, as below, or just by drilling a series of holes. Round the rails to match the rounded ends of the slots. Joint is so strong that you can even leave it unglued for a quick knockdown.

HERE'S THAT OLD HALF-LAP JOINT, but with an extra twist. Side rails are notched to half their width, interlocked, then wedged into cross slots in this table leg. Slots can be made with router

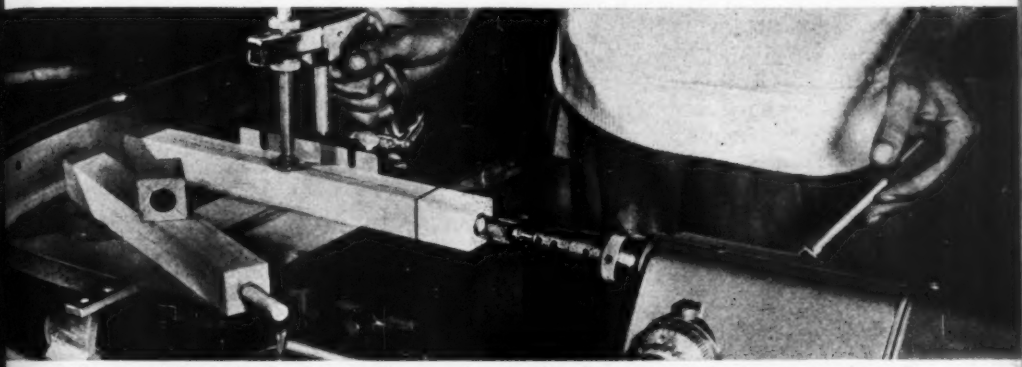








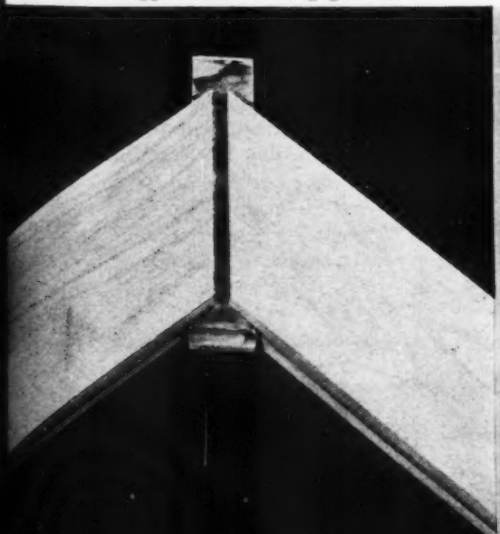
WEDGED DOWEL JOINT. If a board is too thin to take a locking dowel through the edge, use a wedge like this to expand the main dowel. After the glue has dried, sand off the excess dowel and wedge flush with rail. Furniture legs mounted this way will take heavy loads.

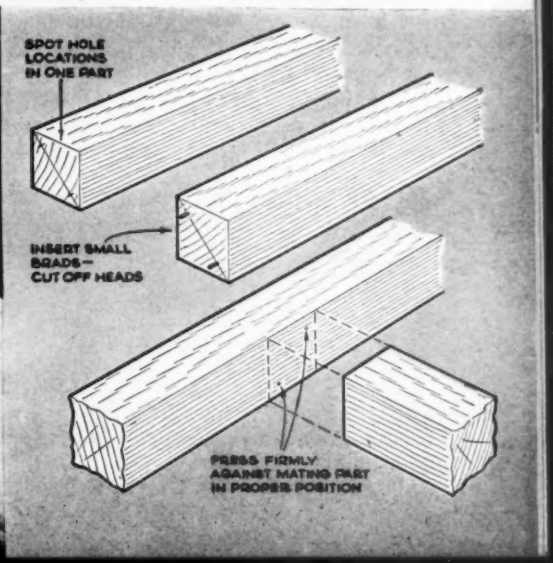


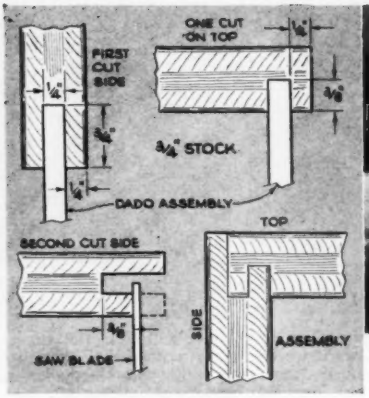
drill press will form the dowel (actually a round tenon) and a few saw passes will cut the waste block loose. Feed the cutter slowly as you cut the dowel. In a vertical setup, swing the drill-press table up 90°, and clamp down the work so that it is in line with the spindle.

THE MITER, actually just a butt joint cut diagonally across the wood, gains plenty of strength through use of a spline, a thin piece of wood that is slipped into matching grooves.

LINING UP DOWEL HOLES for blind doweling is easy if you drive brads in one part, cut off their heads and then press them against the mating part to mark it for accurate drilling.







INTERLOCKING RABBET AND DADO make a sturdy cabinet joint and hide most of edges. On veneer plywood, widen the rabbet so veneers meet.

[*Continued from page 161*]

or so will give you what you need—strength and good looks.

What's wrong with a butt joint when you reinforce it with dowels and glue? Even on projects like drawer fronts, dowels will do the work of dovetails. You can even let the ends show through for a handsome pegged effect and cut a decorative saw kerf along the joint.

Using a double-dowel joint prevents twisting, actually gives you the strength of the fussy old mortise-and-tenon, yet requires only a relatively simple drilling operation. Where dowels must withstand a straight-out pull, you can lock them with smaller cross-pin dowels.

Half-laps make it easy to strengthen crisscrossing braces or corner joints and keep the pieces in the same plane. You can cut them accurately if you clamp both pieces and slot them, to exactly half their depth, on a dado cutter.

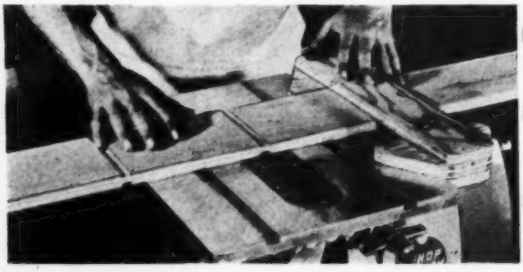
The craftsman who leisurely builds an expert rare-wood piece will still take a year to make a grandfather's clock. But that's not for weekend woodworkers. We can all happily substitute a dowel for a dovetail any day—especially if the joint is just as strong. END

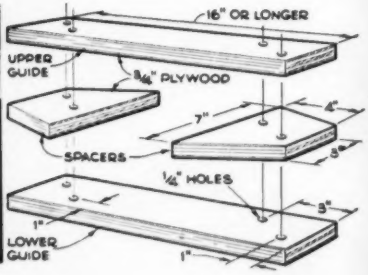
Guide Cuts Dadoes Back to Back

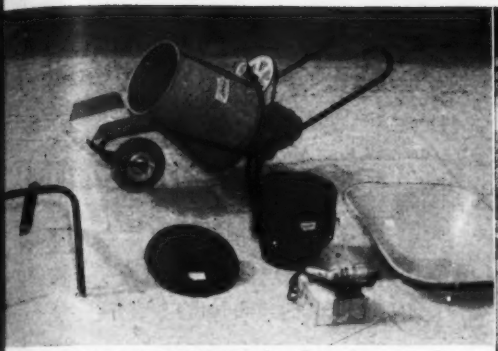
USE this clamp-on guide for accurately cutting dados on opposite sides of a board, or for cutting dadoes in long pieces that are hard to handle with the saw's miter gauge.

Cut the parts from ¾" plywood, making the spacers slightly less than the thickness of the stock being worked.

Measure the distance from the dado cutter to the left edge of the saw table and clamp the guide square across work at that point. Press the guide firmly against the saw table and cut the first dado. Then flip the board over without disturbing the guide to cut the second dado exactly in line with the first.







SPECIAL ATTACHMENTS for the mixer are, from left to right, paddle assembly for mortar or dry mix, cover plate, screen for sand or gravel, adapter mount for ¼"-drill drive (mixer can be bought without motor if buyer prefers), and interchangeable wheelbarrow body.

LAZY-MAN'S VERSION of the barrow mixer has an independent, stationary drive unit. Lifting the barrow off the drum-turning belt for transport automatically shuts off the motor.

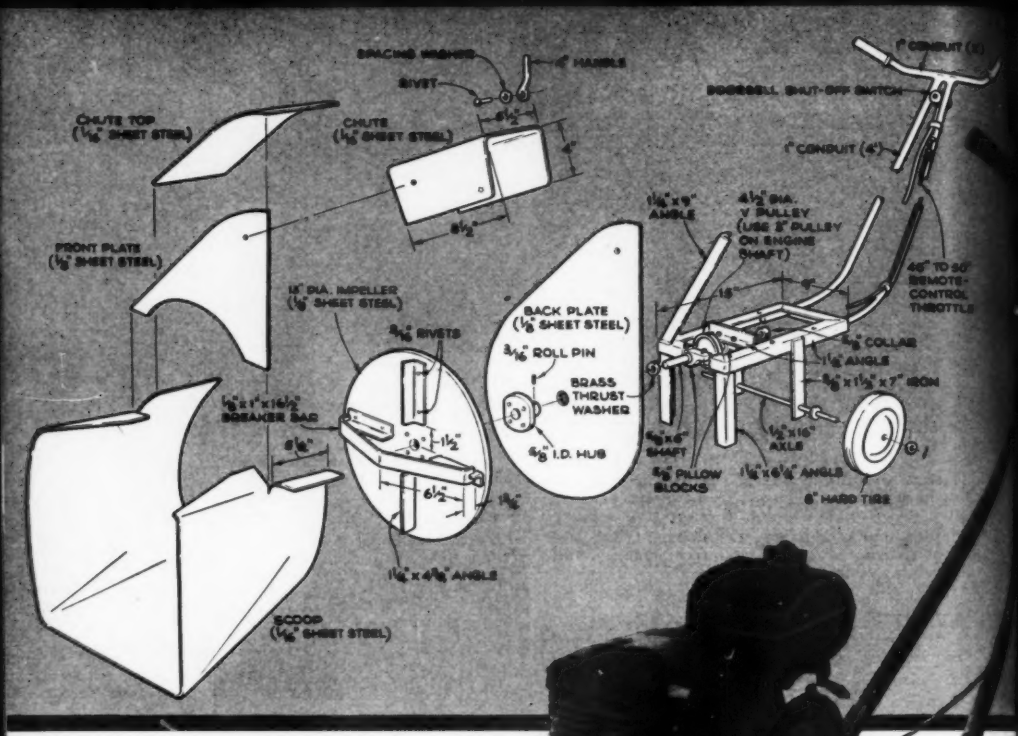
PINT-SIZE VERSION of a ready-mix truck, this wheelbarrow mixer can be pushed to the job and each batch dumped where it's wanted. Model shown has drive unit attached to the frame.

Barrow Mixer Delivers the Concrete

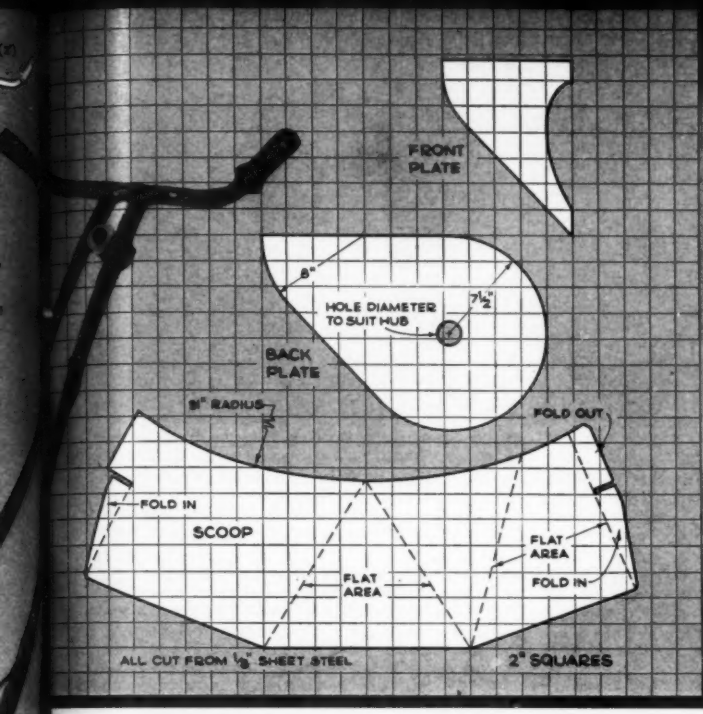
BIG enough to handle a large-size sack of prepared concrete mix, a new electric-powered cement mixer becomes a wheelbarrow to cart each batch to the job. This portable feature speeds operations on many light contracting jobs. It also makes the mixer handy for do-it-yourselfers, who may soon be able to rent such machines.

The wheelbarrow mixer comes in two models. Both have identical tubular frames, 10-inch pneumatic wheels, and 90-pound-capacity drums. The difference is in the driving mechanisms. In one the motor is permanently mounted on the frame. The other has an independent, stationary drive. When concrete or mortar is being mixed in the two-unit model, the barrow is spotted above the power unit, with its drum resting on a driving belt.

Manufacturer of the barrow mixers is Graybill Industries, Inc., of Spokane, Wash. Prices range from $85 to $100.



FACTORY-BUILT JOB? This homemade snow blower could pass for one, with all welds ground down neatly and a sleek coat of rust-inhibiting paint. Nice balance makes it easy to handle, and a four-horse engine salvaged from a motor scooter gives it plenty of power for deep drifts. Assembly drawing shows construction. Each square on the pattern represents one inch.



I built

A Snow Blower for $25

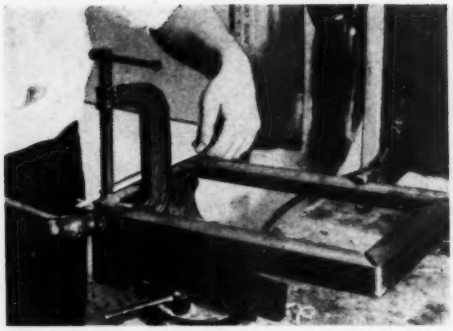
By E. F. Lindsley

MY SNOW shovel has gone the way of red-flannel underwear and the warming pan. I've replaced the old scoop with a rugged little snow blower that I built for less than $25. Of course I spent enough time on the project to represent several years of snow shoveling. But this was a lot more fun. It was also easier on the back and heart muscles.

So is the snow blower, when I nose it into a deep-drifted walk or driveway. It glides through wet, heavy snow with the nonchalance of a Great Lakes icebreaker. Besides, my wife likes to use the snow blower. She wouldn't think of touching a shovel.

Power to spare. The heart of my machine is a four-horsepower motor-scooter engine that I picked up, secondhand, for $10. While commercial blowers are generally equipped with one- or 1½-hp. engines, I had seen them in action and decided that they were underpowered for our Wisconsin winters. Revving up to 3,760 r.p.m. at full throttle, my engine turns the blower shaft at a brisk 2,420, and with plenty of torque for any snow-clearing job. Without a protective chute, it would toss chunks of snow the size of coconuts a good 40 feet, or far enough to shoot them through our neighbors' picture windows.

As an amateur welder I found the blower a good beginner's project, one that paid me back in part for my welding-equipment investment. But it isn't necessary to own a "sputter box" to build a similar, low-cost plow. Any welding service would handle that end of the job for

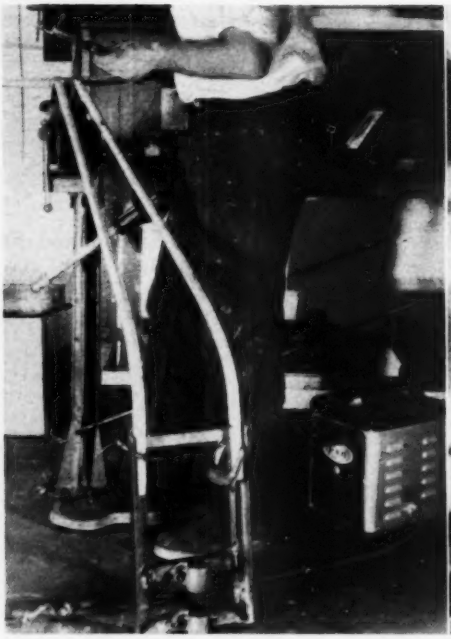


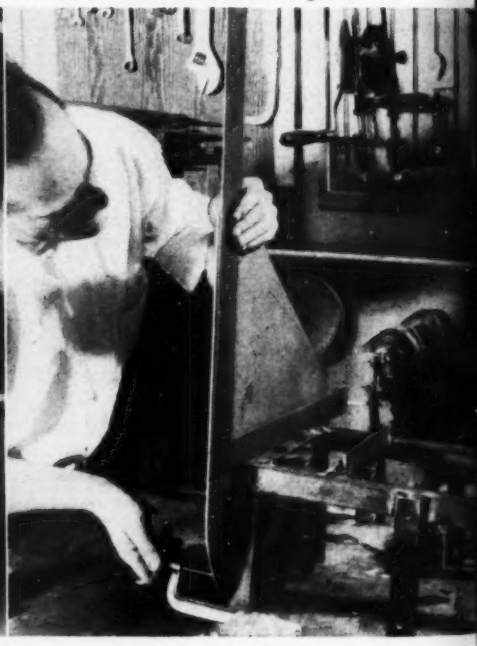
1 THE FRAME was made from a 4′ length of angle iron. I cut 45° angles at both ends and sawed out 90° notches for the vise-and-hammer-bent corners. A C-clamp held the free corner in alignment while I carefully trued up the frame for welding.

2 MOUNTING-BOLT HOLES were drilled in the frame, and in a cross member welded to it, for the engine and the two pillow blocks used as impeller-shaft bearings. I made the pillow-block holes slightly oversize (7/16″) so the bearings could be accurately aligned.

4 HEAVY ELECTRIC CONDUIT, tailor-bent and brazed, formed the handle, although an old cultivator handle would have done the trick, too. I cut notches in the rear frame member for the lower handle ends and used my sputter box again for brazed connections.

5 SQUARING THE FRONT SUPPORTS for the blower housing was just as important as getting the wheel mounts aligned. With these uprights true and flush with the front of the frame, the rear housing plate wouldn't be twisted out of contour when I welded it in place.



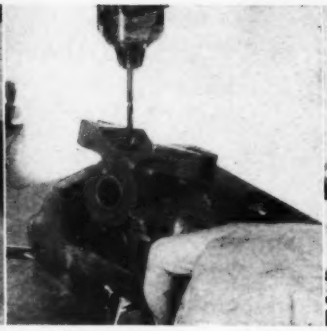


a few bucks, if given the precut parts.

Building tips. If you plan to build such a plow, here are a few tips:

Be sure to balance the impeller. An unbalanced flywheel is dangerous.

When building the frame, remember that the engine's center of gravity should be just a bit ahead of the wheels to make plow-handling easy. If in doubt, finish up the machine and then slide the engine



3 FRONT PILLOW BLOCK needed doctoring to fit behind the forward edge of the frame. After hacksawing off one face of the pillow block (left photograph) I drilled new oil holes in the undersides of both bearings (center), as they would be inverted on my finished plow. Before lining up the pillow blocks with the shaft in position (right), I cut a notch in the forward end of the frame to admit a heavy brass thrust washer and the rear end of the impeller hub. A heavy-duty pulley was to fit between the bearings, to take the V-belt drive.

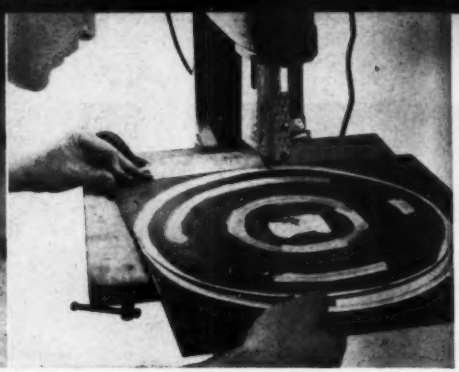
6 LAYING OUT THE SCOOP could have given trouble to even a pattern maker. To play safe, I cut a cardboard template and taped it in place. Once I was sure that the mockup was correct, I transferred the outline to 1/16" sheet steel and bandsawed out the part.

7 STRONG-ARM TACTICS gave my scoop the desired curve at the rear and a roughly squared front. A heavy cornice brake would have done a professional job of bending. Without one, I used a length of railroad iron clamped to the top of my workbench. *(Please turn the page)*

forward and backward experimentally, to make sure there is enough, but not too much, downward pressure on the bottom edge of the scoop.

Bear in mind that your engine has to be in top shape to start well in winter. Among other things, check the spark-plug lead wire. If the insulation is cracked, snow moisture will sap the kick before it ever sees the points.

8 WELDED TO THE BACK PLATE (I started with a tacking weld at the bottom of the curve), the scoop was ready for the front blower-housing plate. With this plate tacked in place, I positioned a 5½"-wide strip of 1/16" sheet steel for welding on top of the housing.

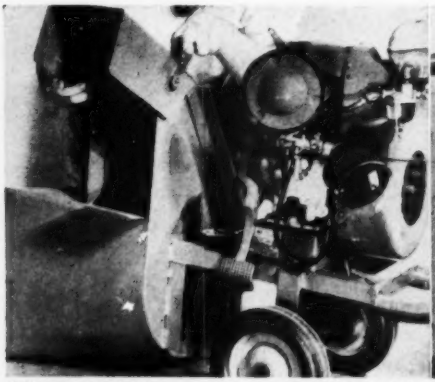


9 IMPELLER had to be perfectly round for safety. To cut the circle, I drilled a center hole and sank a wood screw through it and on into a piece of plywood clamped to the saw table. Then I rotated the metal into the blade. White shoe polish made guide marks easy to see.

10 FOUR IMPELLER BLADES, cut from angle stock, had to be same size for balance. I was equally fussy about spotting rivet holes, both in blades and impeller, working from center on latter. I enlarged impeller's center hole to fit shaft.

11 PRESS-FITTED HUB for impeller came from parts bin of a farm-machinery dealer. I used tough drill rod for the shaft; soft steel would have taken too much of a beating in heavy snow. A roll pin anchored hub on shaft.

12 BREAKER BAR, welded to a pair of blades, completed impeller. I placed a brass thrust washer on the shaft behind the hub and slipped the shaft through the bearings. With the impeller pulley between them, I bolted the impeller on the hub.



13 SNOW CHUTE wasn't necessary, but it might keep flotsam from sailing way out onto my neighbor's property. I belted the engine pulley directly to the impeller pulley, as a belt tightener wouldn't work well in wet snow. Shims between the engine and frame maintained tension.

14 BRACKET, brazed to the handle, gave me a place to anchor the engine's throttle control. As a safety measure I added a push-button "panic switch," mounting it on a washer brazed below the crossbar. Wire led to magneto's primary connection to ground it out. END

Industry uses this trick. Why not you?
You can sometimes triple production by—

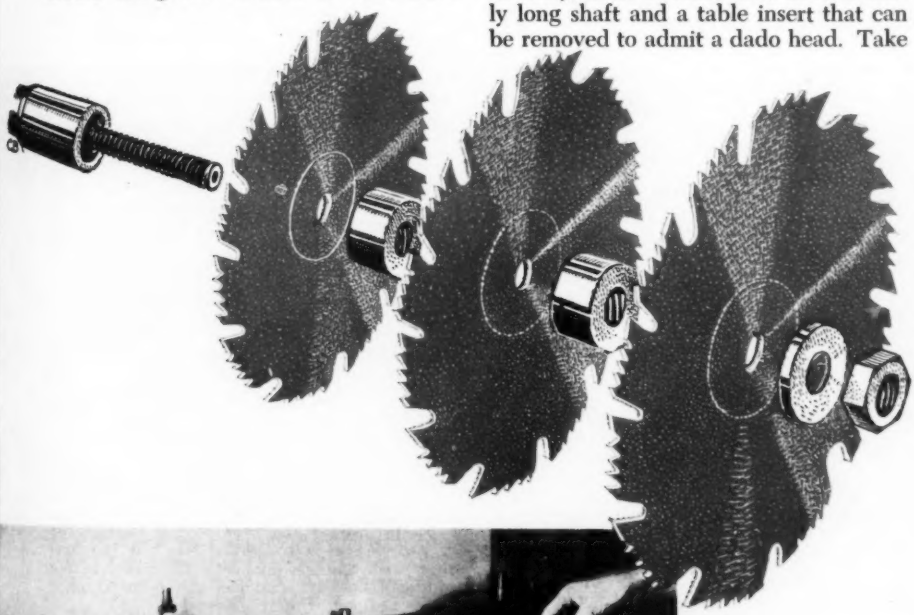
Using Three Blades for Faster Saw Jobs

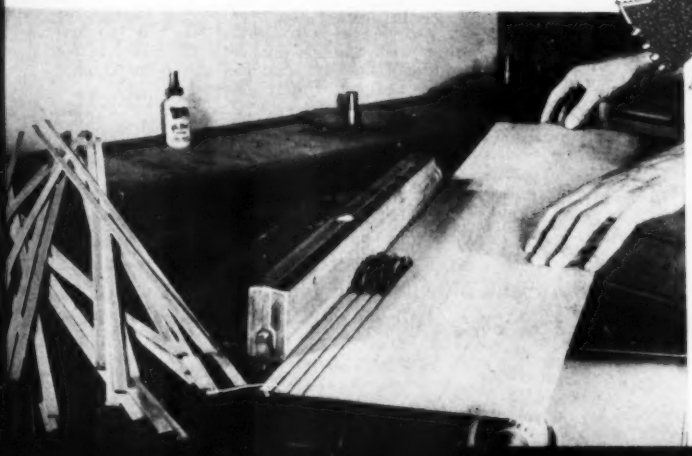
TWO or more circular-saw blades, turning on a single shaft, speed production on thousands of industrial duplicating jobs. Yet few home craftsmen have ever tried this time-saving, multiple-cutting setup.

They're passing up a good bet, and so are you, if you own a table saw, an extra blade or two, and a handful of washers.

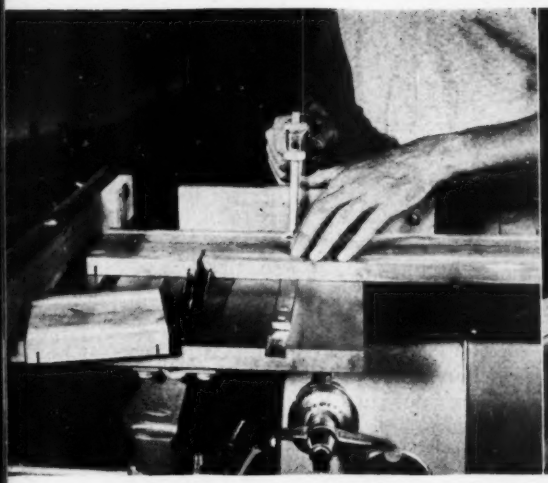
Mount the spare blades on the saw arbor, using the washers to hold them the desired distance apart. One pass of the stock through the blades and you have two or three accurately spaced cuts. With this setup you can double or triple your output on all sorts of repetitive sawing chores that call for parallel cutting.

There's only one limitation. The spacing of the multiple cuts is restricted by the length of a saw's arbor shaft and the width of the saw slot in the table. Fortunately, most circular saws have a fairly long shaft and a table insert that can be removed to admit a dado head. Take

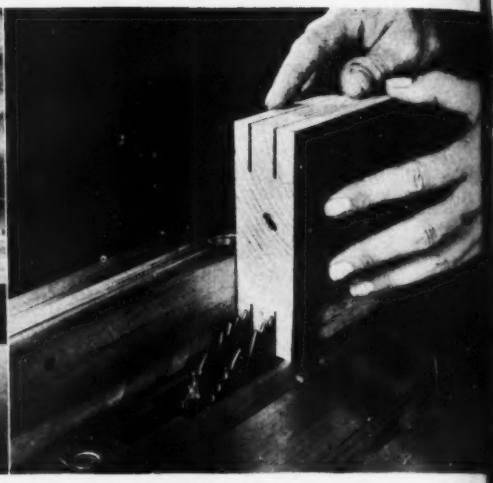




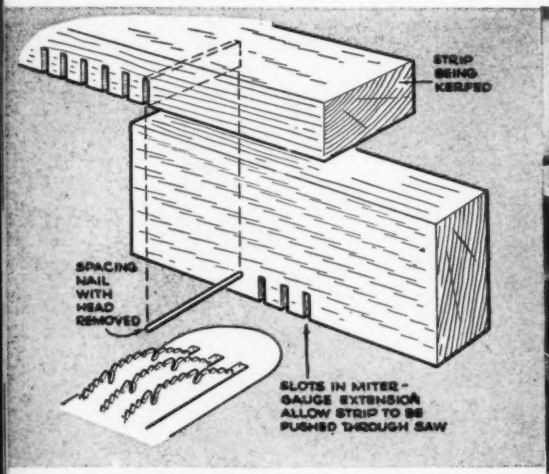
THREE-BLADE SETUP triples production of identical parts. Even with heavy stock, multiple cutting won't tax a saw any more than making a wide dado cut. But the blades should be sharp, and the rate of feed fairly slow.



BLADES OF VARYING DIAMETERS cut identical drawer parts and run off parallel grooves for rabbets at the same time. Here, an 8" blade parts the wood; 7" blades cut the grooves.



MAKING TWO CHEEK CUTS for a tenon is easy. If a duplicate tenon is cut on the opposite edge of the stock, as here, keep the same board face against the rip fence for both sets of cuts.

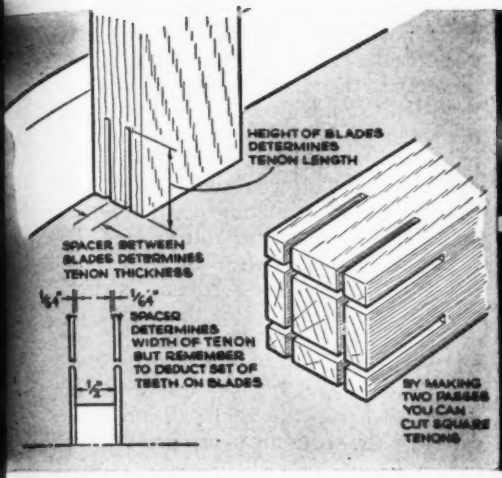


WHEN KERFING UNDERSIDES of strips or panels to be bent, pass the stock completely through a set of blades of equal diameter. Then drive a nail into the miter-gauge extension, as shown in the drawing at left, above. Slip the last kerf made with the first pass over the nail and the work will be advanced just the right distance for the next set of multiple cuts.

out the insert and you have enough leeway for a wide range of setups.

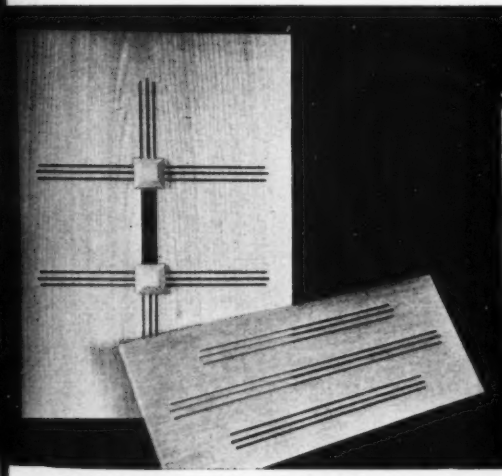
Multiple-cutting uses. Running off a large number of identical strips or slats is an obvious use for multiple cutting. With a rip fence spacing the first cut, you'll get as many strips with one pass as there are blades on the arbor.

Similarly, you can make repetitive kerfs or grooves on the undersides of strips or panels that are to be curved. Or, using blades of varying diameters, you can saw through a board for an edge cut, and at the same time make a shallow cut for the side of a rabbet, or two shallow cuts for a groove.

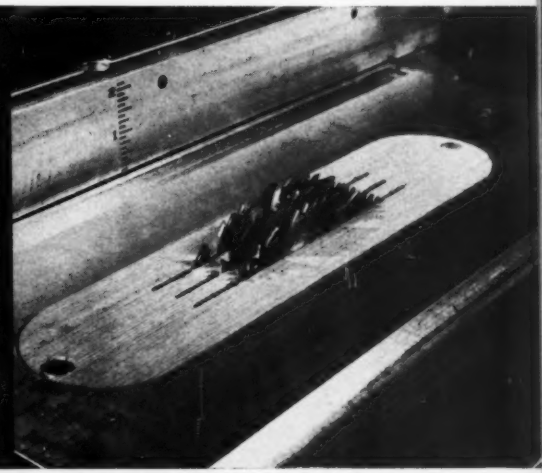


BLADE HEIGHT above table determines tenon length. Allow for tooth set when spacing blades for tenon thickness. Two passes with one saw setup blanks out an accurately square tenon.

MULTIPLE SPIRAL GROOVES are run off on dowels or spindles the easy way, using an angled miter gauge. Here, three unequally spaced blades produce a "peppermint-stick" pattern.



MULTIPLE CUTTING produces decorative panel louvers. For "stopped" kerfs like these, tilt the stock down onto the blades from the far edge of the table. Use a stop block to end cuts.



SPECIAL SAW-TABLE INSERT, made of thin wood or hardboard, will protect the work—and you. Multiple-saw setup shown cut its own openings when the table was lowered onto the blades.

Making the "cheek" or side cuts for tenons is another pushover. Here you use a rip fence and two blades of equal diameter. Set the blades the correct distance apart for the tenon thickness and adjust the fence to center the tenon section on the stock. The blade height determines the tenon length. For square tenons, make the first two cuts, then turn the stock 90° and run off the other two cuts with the same saw spacing.

Decoratively, multiple cutting can be used to saw parallel grooves or slots in panels and screens, or to make multiple spiral grooves in doweling or spindles. All sorts of repetitive designs will occur

to you, once you're familiar with the basic setups for multiple sawing.

Setting up the saw. The washers used to space out the blades for multiple cutting should be perfectly flat. Otherwise the blades may wobble and chew out too much stock. For true alignment, shaft bushings make better spacers than washers. But being thicker, they don't allow as great a range of settings.

Place the first blade against the shoulder on the inner end of the arbor shaft. Follow it with the necessary number of washers or bushings and slip on the second blade. Add more spacers if you mount a third blade. Either way, use the arbor washer and nut to draw the assembly tight.

When making cuts that are to be identical, be sure that the blade diameters are exactly the same. If you are teaming up a new blade with one or two old ones, better have a professional touch them up so they mate—previous sharpenings will probably have reduced the diameters of the old ones. Also be sure to scribe or otherwise mark the blades and the shaft so you will always get them in the same mating position when you remount them for future jobs.

Types of saw blades. Multiple cutting is no different than ordinary sawing, when it comes to choosing the right type of blades. But remember that you are adding to the load when you make several cuts at once. Feed the stock in slowly. To ease the load still more, be sure that the teeth are sharp and free of dirt and gum—they should be, anyway. Bear in mind that hollow-ground blades,

PROP UP THE TARGET with a removable back support. Note the pin-and-dowel hinging and the notches for the cross-stringer. A simpler support would be a single leg hinged to the top of the frame.

Target Swallows Well-Aimed Snowballs

GIVE a boy an interesting target for snowballs and you won't be one yourself. The bull's-eye in this homemade target is the clown's open mouth.

Nail a 3′-by-4′ panel of ¼″ hardboard

which have no tooth set but only a slightly narrowed cross-section below the teeth, drag more than regular blades.

Don't use hollow-ground blades for deep grooving, or push them beyond their capacity in open cutting, or they will burn both themselves and the work. A blade with tooth set is best for most multiple cutting, unless you want the cut to be smooth-edged, as in decorative work.

If you own a dado assembly, you can use the two outside blades for cutting light strips, provided these blades are hollow-ground. Don't try it with flat-ground dado blades—ones with neither a set nor tapered sides. They're sure to burn.

Whatever blades you use, allow for the widths of the cuts when you space them on the arbor. For example: If you plan to use two regular blades to cut a tenon, be sure to allow for the set of the teeth. Two such blades, placed ½" apart on the shaft, won't give you a ½"-thick tenon. If the set of the teeth is 1/64", you'll get a 15/32" tenon. *Measure the distance between the teeth.*

Final note. When you remove the saw-table insert to admit two or three blades, a special insert is in order. It's a simple matter to trace around the outline of the regular insert on hardboard or plywood and cut it out to fit the opening. Make the openings for the blades by attaching the new insert to the table with the regular countersunk bolt setup and then lower the table onto the turning blades, or raise the arbor, and they'll cut their own slots.—*R. J. De Cristoforo.*

to a frame of 1"-by-2" lumber and build a back support of the same material. Pin the support to the target with removable dowels for easy storage.

Prime the panel and the back support with gray paint and draw the clown's face around a 9" opening cut with a keyhole saw. Paint the face with bright-colored enamels, leaving the prime coat as a background.

How to Choose the Right Tone Arm

HI-FI REPORT

Just a support to hold the pickup? Yes, but everything about it affects the music you hear.

By Hubert Luckett and Martin Mann

YOU may be chewing up five-dollar bills. With the tone arm on your record player, that is. An LP record costs the better part of five bucks, and a few plays with an inadequate tone arm will rip out the fine music you bought.

That's one reason it doesn't pay to skimp on the arm. It and the pickup cartridge (PS, Nov., p. 214) are the only hi-fi components that can hurt your investment in records.

There's another reason, too. The arm has what seems a simple job: to support the pickup while the stylus moves from the starting to the finishing grooves of the record. This has a lot to do with the quality of the music you hear. The arm must be rigid enough to resist twisting, have inertia enough to hold the cartridge still while the stylus vibrates, and be light enough to glide easily over warped records. Most important of all, it must hold the pickup in correct relationship to the groove—a problem with no easy answer.

POPULAR SCIENCE compared specifications for 11 quality tone arms. Some of the specs we measured ourselves, others came from the manufacturers. We played all the arms. We found differences that a shopper should know about.

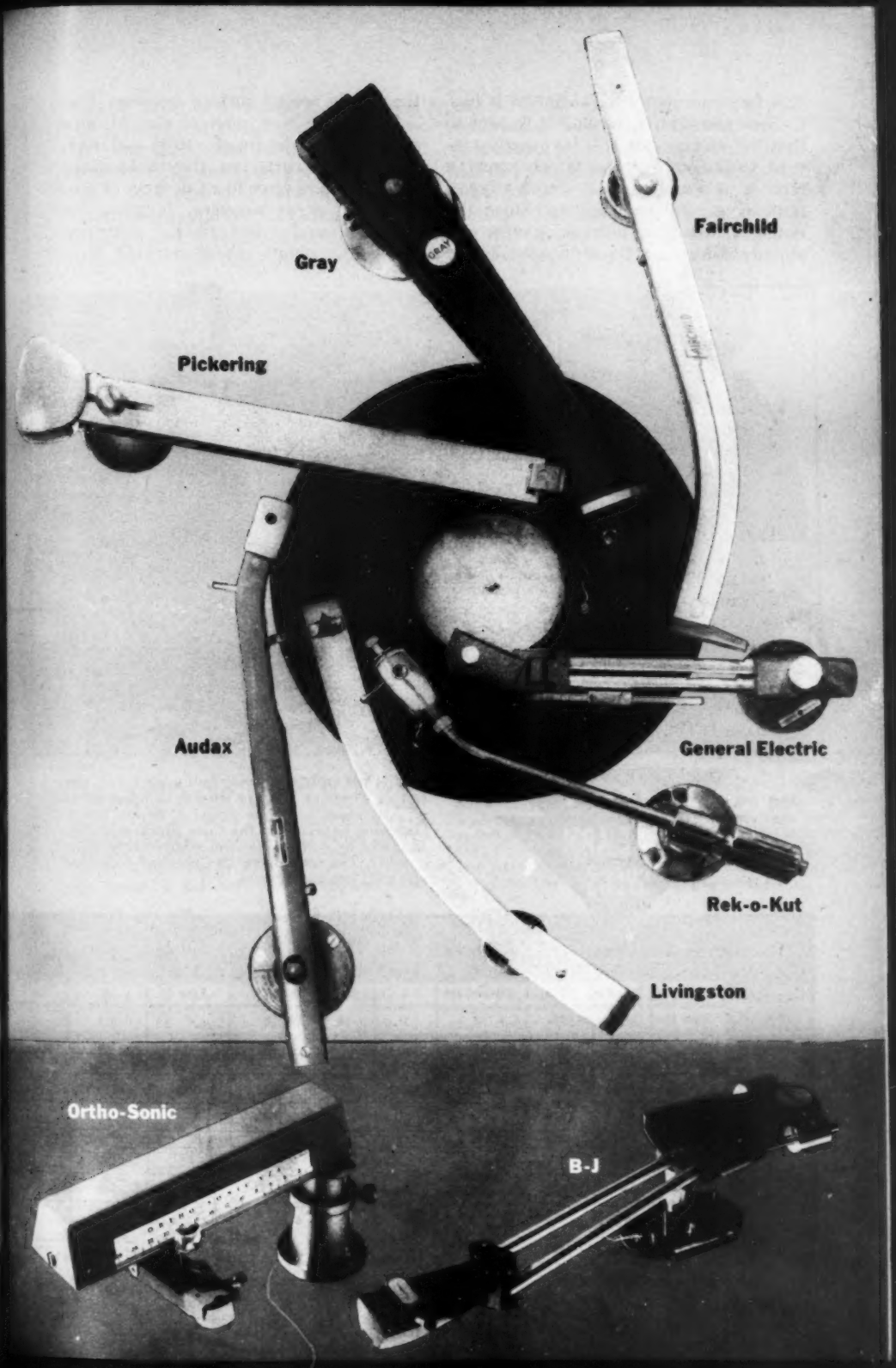
A problem in geometry. The cutter that records music is moved across the record blank by a lathe screw. It travels in a straight path—a radius of the record—with its axis tangent to every groove it cuts. Ideally, your tone arm should hold the pickup cartridge so that it moves exactly the same way—along a straight-line radius of the record with its axis perpendicular to the radius and tangent to every groove. (See the detailed sketches on page 179.) Then the stylus would be vibrated the same way that the cutter vibrated, and music would come off the record sounding the same as it did when it was put on.

Most tone arms cannot do this. They are pivoted at one end and swing the pickup in an arc, not a straight line. So they hold the pickup at an angle to most grooves instead of tangent to them. This angle is what engineers call tracking error. It varies from groove to groove as the pickup swings through its arc.

Longer arms? The problem could be virtually solved if you had room for a very long tone arm, with an effective length of three or four feet. It would still swing the pickup in an arc, but the short arc across the record would be very flat, almost a straight line. Arms of manageable proportions—the longest we checked had an effective length of 12½ inches—swing the pickup in an arc that is not flat at all. Two tricks of design, however, work together to reduce the tracking error that short arms cause.

The first trick is "overhang." The pickup is located so that the stylus will swing beyond the center of the record instead of meeting it. This does not make the arc of the swing any less curved. And it makes actual tracking error greater. But it does change the way the tracking error varies from groove to groove. Now the fluctuation in tracking error goes through two cycles. It can be made a minimum at two grooves. And the *range* of fluctua-

Third in a series on shopping for hi-fi components. Next month: Amplifiers.


Fairchild
Gray
Pickering
Audax
General Electric
Rek-o-Kut
Livingston
Ortho-Sonic
B-J

tion from minimum to maximum is less.

Then the arm is "offset." It is bent so that the pickup axis will be exactly tangent to the grooves for which tracking error is at a minimum. At those grooves tracking error becomes zero. Since the range of fluctuation in tracking error was already made less, tracking error across the whole record surface becomes low.

That's the way nine of our 11 tone arms were made. By offsetting and overhanging the cartridge, they hold maximum tracking error to six degrees or less.

Where error matters. Juggling the overhang and offset of the cartridge moves the points where tracking error

THIS IS THE OCTOPUS (only four arms here), the test rig POPULAR SCIENCE used to compare pickup cartridges and tone arms. A switch lets a "listening panel" hear the same music repeated instantly by one pickup-arm combination after another. The units were also checked individually with test instruments.

HI-FI TONE-ARM SPECS

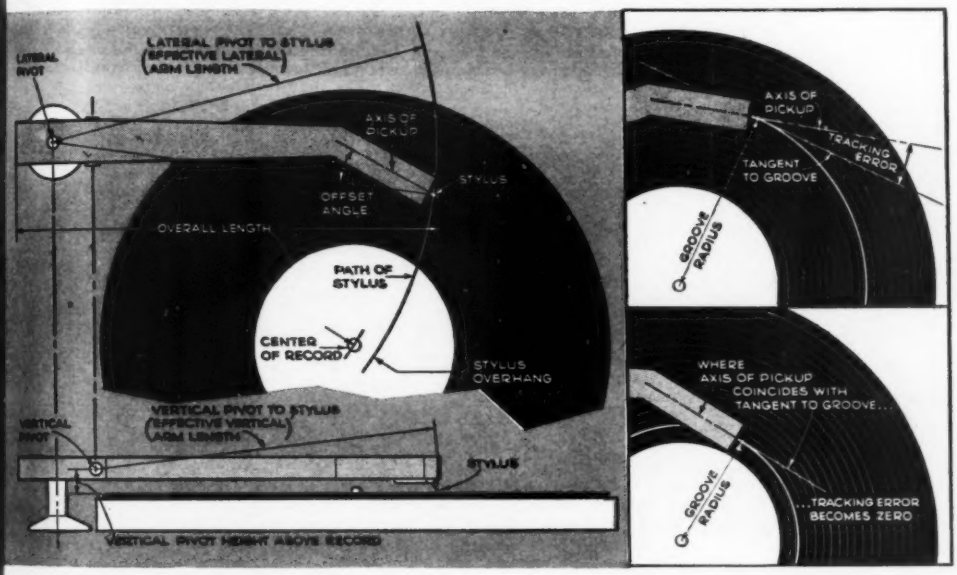
AUDAX	KT16[a]	$17.55	13½	2⅞ and 5⅛	2	14	13/16	12⅛	10	
B-J	Super 90	35.00	12¼	c	1	c	c	c	8¼	
FAIRCHILD	280A	33.95	14	2⅛ and 4¼	3	20.5	½	9⅛	7¼	
	281A	35.95	16	2¼ and 5⅝	3	19.7	17/32	12½	10	
GENERAL ELECTRIC	AI-500	31.95	10¾	2¾	2½	20	17/32	8 25/32	2⅛	
GRAY	108-C	39.95	14¾	3	4	14	⅜	11	11	
LIVINGSTON	Universal	24.95	13¾	2½	6	14.5	⅜	9 13/16	9	
ORTHO-SONIC	V/4 100	35.95	7¼	c	0	c	c	c	2¼	
PICKERING	190 D	31.50	14½	2½	5	14	11/32	10¾	2½	
REK-O-KUT	A-120	26.95	12¼	2¼ and 4⅛	3½	21	17/32	8 25/32	8 25/32	
	A-160	29.95	15¾	2⅞ and 6	2½	22	¾	11¾	11¾	

NOTES: [a] This is a kit. Factory-assembled arm, PRO16, costs $30 [b] Interchangeable carriers for various cartridges

is zero. This also makes a difference.

Tracking error causes the most distortion near the center of the record. On 12-inch LP records you get best results with a tone arm that puts its minimum tracking error at a record radius of about 2½ inches and its maximum error at about 5¾ inches. Some arms are designed to play all kinds of records and have to compromise their tracking errors over a wide range, from 1⅞ inches (inner radius of a 78-r.p.m. record) to 7¾ inches (outer radius of a transcription disc).

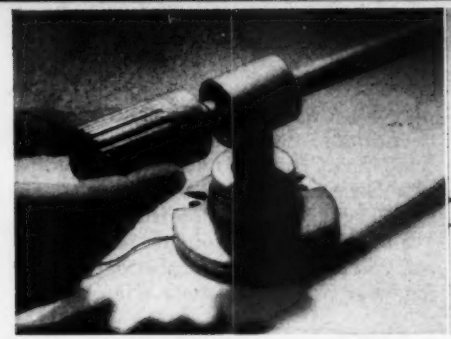
Since offset and overhang are so critical, you have to be careful about mounting your pickup and tone arm. A slight



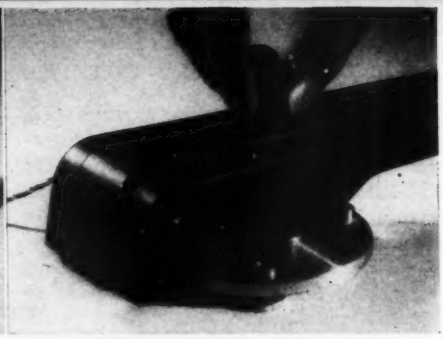
EVERY SPECIFICATION MATTERS to the way a tone arm plays music—and treats your records. Sketches identify data in the chart below. Fundamentally, the accuracy with which an arm can do its job is limited by effective lateral length. Other things being equal, the longer the better, if you have enough cabinet room. Short arms cause tracking error, which is the angle between a tangent to the record groove and the axis of the pickup. The error can be reduced by overhanging and offsetting the arm. Offset is not the angle of hook in the arm, but the angle between the pickup axis and a line from the stylus to the lateral pivot.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
½	yes	needle	needle	yes	weight	plug-in heads[b]	shorter version available (KT12 kit $14.55)
0	no	needle	needle	no	weight	plug-in heads[b]	pantograph arm—tracking force varies as arm moves
⅞	yes	needle	needle	yes	spring	slides[b]	removing cartridge slide automatically shorts amplifier input and silences system
⅞	yes	needle	needle	yes	spring	slides[b]	
11/16	no	ball	ball	no	weight	slides[b]	longer version available (AI-501, $35.50)
½	yes	cone & point	cone & point	no	weight	slides[b]	has adjustable damping on both pivots
5/16	no	ball	needle	yes	weight	screw	
2	c	ball	ball	yes	weight	clamp	radial arm—cartridge carrier moves on stationary track
½	yes	ball	needle	yes	spring	screw	snap-in mount for Pickering Fluxvalve cartridge
⅝	yes	ball	point	no	weight	plug-in heads[b]	adjustable counterbalance locks itself in position automatically
⅝	yes	ball	contact ball	no	weight	plug-in heads[b]	

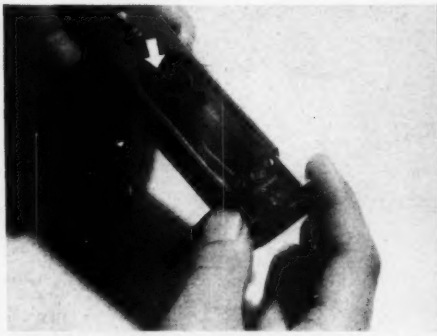
[c] This information does not apply to this type of tone arm



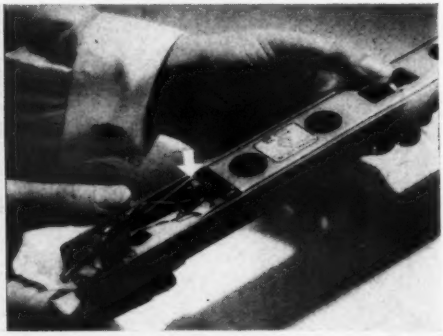
COUNTERBALANCE IS LOCKED IN POSITION on Rek-o-Kut arm by spring-loaded internal nut. One turn of counterbalance changes stylus pressure on record one-half gram (on 16-inch arm).



KNOB ADJUSTS DAMPING OF PIVOTS on Gray tone arm to control low-frequency resonance. Damping is varied to suit the playing conditions. Screw jacks simplify leveling of this arm.



ELECTRICAL CONTACT IS AUTOMATIC when pickup is inserted in Fairchild arm. As spring contacts move, they also open a silencing switch (arrow) and the system is ready to play.



STYLUS PRESSURE IS SET BY KNOB (under thumb at right) on this Pickering arm. Knob adjusts spring, which is attached to the arm's vertical hinge. The arrow points to vertical pivots.

twist to the pickup or a 1/32-inch error in overhang will make even the best-designed arm perform poorly.

Why the stylus pushes sideways. The overhung-offset design pretty much licks the problem of tracking error, but short tone arms bring another trouble that you might not expect. The friction between the stylus and the groove causes a force tangent to the groove. This force tries to pull the stylus ahead; the tone-arm pivot holds the stylus back, but this holding force is not tangent to the groove. The two angled forces combine to press the stylus against the *inner* side of the record groove. It's the same thing that happens when you pull the ends of a curved string: The center moves sideways.

The sideways force on the stylus causes distortion of the music and wear on the record. And it calls for added weight on the cartridge to keep the stylus in the groove.

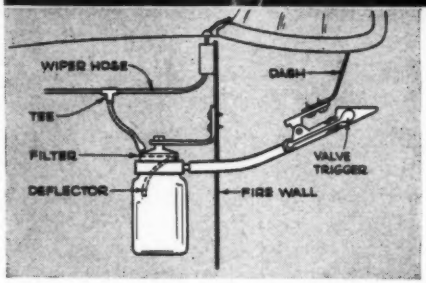
Two other ways out. You're probably wondering why some genius doesn't build a tone arm that holds a rod straight over a radius of the record and lets the pickup slide along it. Then there is no tracking error at all. The Ortho-sonic arm does just that. One trouble with this type is that a tiny speck of dirt on the pickup-carrying rod will jiggle the pickup—and you hear it.

A bigger problem is making the pickup move effortlessly and uniformly along the rod. This the Ortho-sonic design does very nicely. It has a high vertical pivot, however, which may cause more distortion on badly warped records than you're likely to get from most conventional arms.

A different trick is used in the B-J arm. This one is a pantograph and turns the cartridge as it moves across the record. The tracking error is never more than

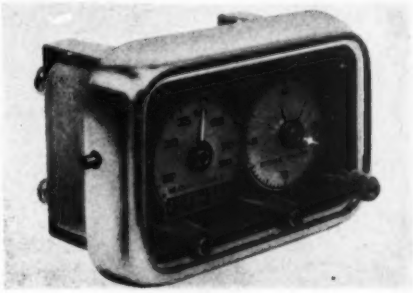
[*Continued on page 220*]

New for Your Car



1. Vacuum Sucks Ash Tray Empty. Press the trigger to open a suction line valve, and contents of this dashboard ash tray vanish into a vacuum jar under the hood. There, sparks die for lack of air. Vacuum is supplied through a tee inserted in the windshield-wiper line or a nipple threaded into a hole tapped in the intake manifold. A deflector and filter keep ashes and stubs out of the engine.

2. Computer Checks Driving Pace. This instrument combines a mileage counter and clock to compute average driving speeds. Mounted under the dash, it runs off the speedometer head. At start of a trip, set one pointer at the pace needed to reach your destination on time. Left dial shows distance traveled; right one minutes behind or ahead of schedule.



More information *about the products on this page can be obtained from: 1. Gray-Tone Industries, Box 142, Pacific Palisades, Calif.; 2. Nisonger Corp., 146 E. 74th St., NYC 21.*

Time-Tested Tips for Winter Driving

THAW A FROZEN LOCK by warming the key with a match or cigarette lighter and quickly inserting it. It may take several attempts, but eventually the key will transfer enough heat to the cylinder to melt the ice.

AVOID A FROZEN BATTERY by keeping it fully charged, and by adding water only when you plan to drive a few miles right afterwards. This will give the water a chance to mix with the battery acid, and once mixed, it won't freeze.

STOW A BAG OF SAND in the trunk and sprinkle it under the rear wheels for getting started on ice. The weight of the sand in the trunk will add traction, too.

WHEN YOU PARK in a freezing rain, tuck cardboards under the windshield wipers to trap the ice as it builds up. When you return to the car, lift out the cardboards and the glass beneath will be clear.

KEEP AN OLD WIPER BLADE in the glove compartment to clear the inside of a fogged windshield. The glass will stay clear a lot longer than if you just smear the condensed moisture around the windshield with the palm of your hand.

SHORTEN THE WARM-UP PERIOD and raise a car's heater temperature on cold mornings by tucking a large piece of cardboard in front of the radiator to keep the fan from drawing in an icy blast of air. In traffic, watch the gauge to keep from boiling.

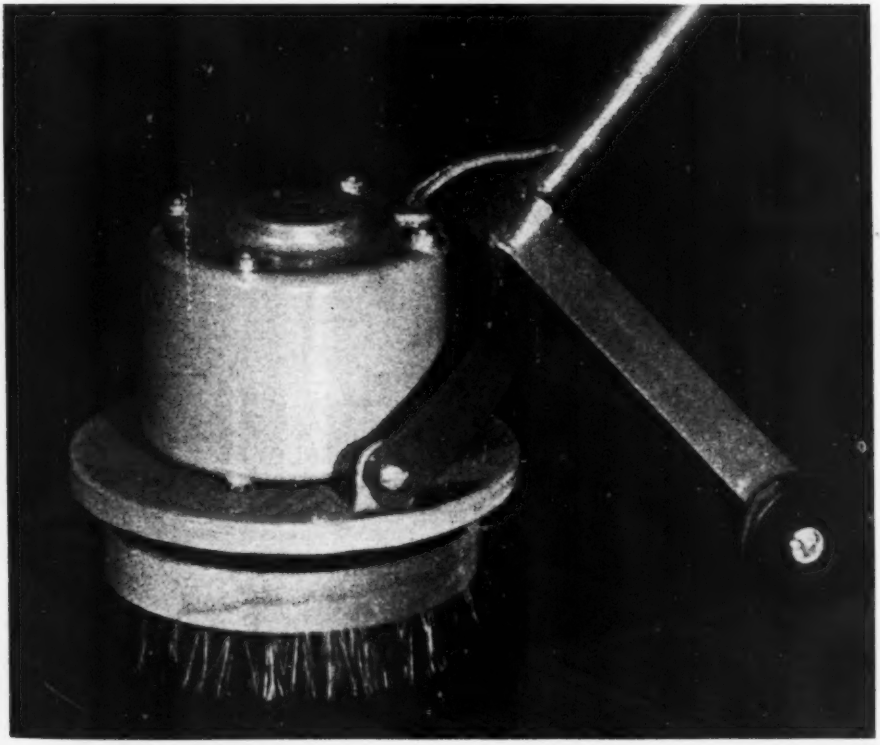
How to Build a Floor Polisher

By John Rogers

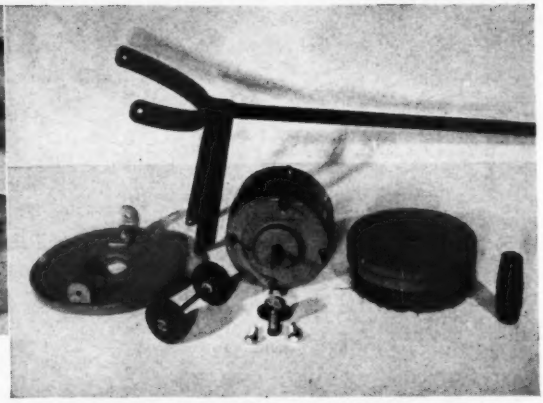
HERE'S a sturdy floor polisher that's as easy to build as it is to use. With it, your wife will have no excuse for glowering you out of your armchair whenever it comes time to wash, wax or buff up the underfooting.

Cost-wise, this polisher shouldn't set you back more than $10 if you use a secondhand motor. Choose a heavy-duty, ball-bearing, constant-speed motor in the ⅙- to ⅓-hp. range. Don't use a vacuum-cleaner motor—they rev up too fast. A 6″ circular brush, available as a replacement for factory-made polishers, comes to about $1.50.

As a base for your motor, turn a 7″-diameter disk from ½″ exterior plywood;

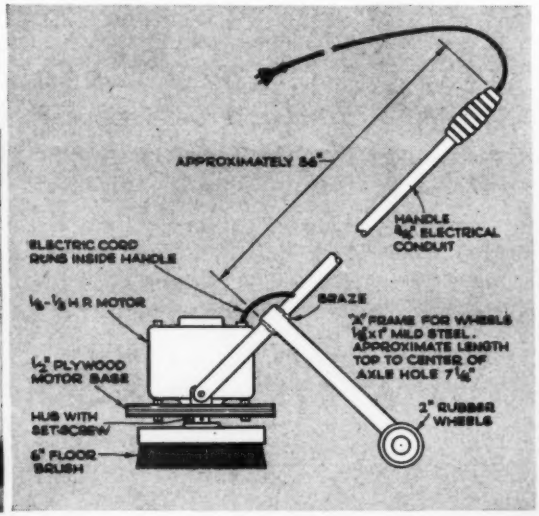


MOUNTING HUB is a washer, brazed to a shaft collar. Tapped holes in underside of hub receive 3/16" bolts passed through mating holes in brush. Bushing adapts ⅜" motor shaft to brush's center hole.



POLISHER PARTS include the brazed handle assembly, plywood motor base, casters with ½" drill-rod axle, motor, mounting hub, 6" brush, and bicycle handle-bar grip.

MOUNT BRUSH ON SHAFT, and rest brushes and casters on floor to determine correct angle between yoke and motor base. Use machine screws or bolts with lock washers and nuts for a firm connection.



bore a hole in the center of this disk large enough to clear the motor shaft, and smaller holes to line up with the bolts that hold the motor housing together. Remove the bolts in the housing and replace them with others that will reach through both the housing and the base. Attach two L-shaped handle brackets near the periphery of the base.

A 3′ length of ¾″ electrical conduit forms the handle. The yoke is bent from ⅛″-by-1″ mild steel, as is the V bracket that supports the wheels. If your shop isn't set up to do a brazing job, take these parts to a welding service and have them tacked together.

Slip a ¼″ steel rod through the axle holes, mount rubber caster wheels and secure them with cotter pins. Bolt the yoke to the motor base and drill a hole in the lower end of the conduit handle as an outlet for the motor lead.

Use a washer, brazed to a collar, for a brush hub. Attached to the brush, this hub is slipped over the motor shaft and secured with a setscrew. END

How to Control Hardboard Expansion

Moisture causes this useful man-made panel to swell in all directions. Here are the rules for keeping it down to size.

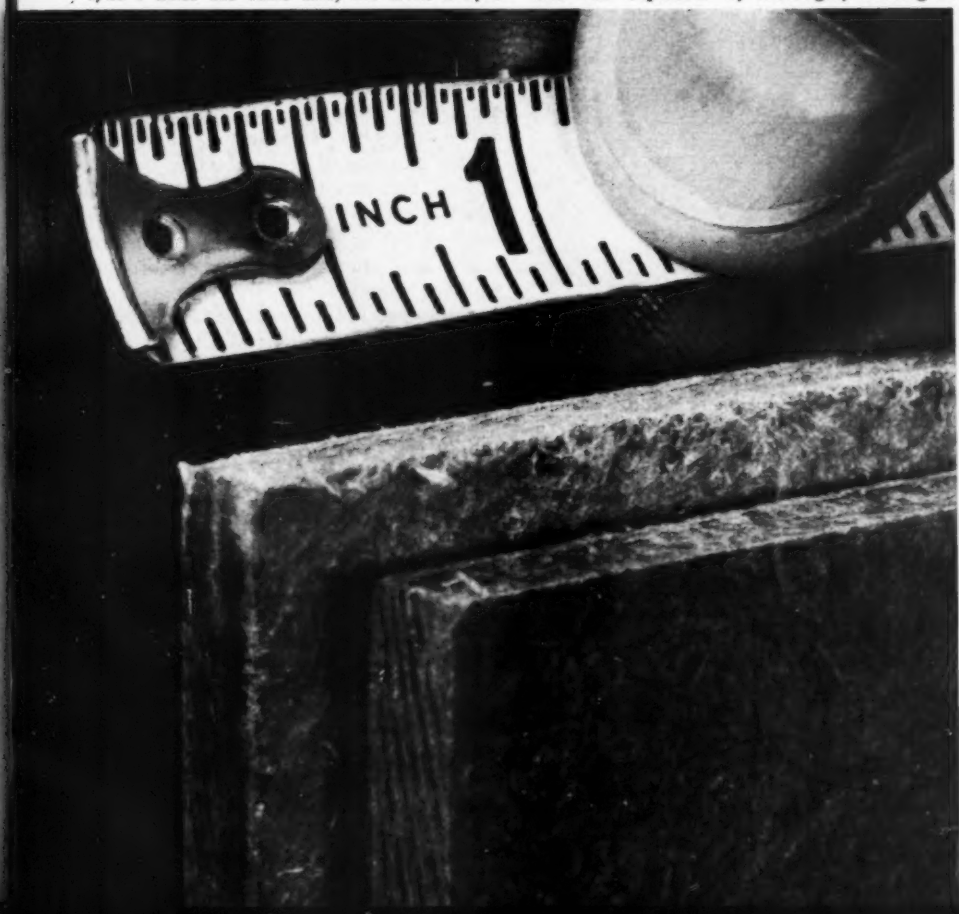
By Darrell Huff

LIKE the wood it's made from, hardboard swells and shrinks with changes in humidity. But unlike wood, which changes across the grain, hardboard blows up equally *all* ways.

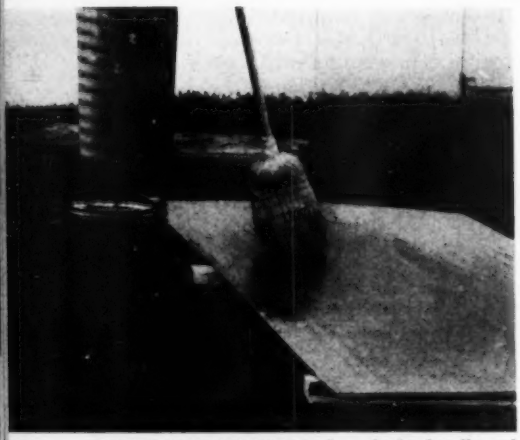
Overlook this when you work with hardboard and you're headed for trouble. When moisture hits, hardboard expands with the force of an explosion. Dry sheets jammed together with tight-fitting joints are bound to start buckling when damp days come. Mount long panels between the floor and ceiling and it's worse. Hardboard expands in proportion to its length —the longer the panel, the bigger your problem.

Hardboard acts the way it does because it has no grain like wood. In hard-

HUMIDITY EXPANDS each four feet of hardboard 3/16". Once the same size, the front 4'-by-4' panel was contracted by baking dry; the rear one was "exploded" by thoroughly soaking it.



IN-PLACE CONDITIONING is all that's needed to counteract hardboard's dimensional changes in normal conditions. Store the panels for at least 24 hours in the place where they'll be used.



WATER CONDITIONING is the rule for hardboard that's to be used outdoors or in high humidity areas. Scrub water into the back surface, cover the panels and leave for at least 24 hours.

EXPANSION GAP is always a good idea whether panels have been conditioned or not. Some manufacturers supply a gap gauge with their panels to aid in spacing them uniformly.

board manufacture, wood fibers are torn apart and pressure packed into dense, hard sheets. The fibers are matted together in all directions. So the expansion-contraction forces of wood are now free to operate in all directions.

A perfectly dry 4'-by-8' panel of hardboard will expand $\frac{3}{16}''$ across its width and $\frac{3}{8}''$ in its length when exposed to extreme humidity. Even the tiny increase in thickness can cause trouble in some places: a sliding door that fits its track on a dry day may bind on a damp one.

To avoid such problems, on those jobs where you'll want to use a smooth panel board instead of wood, condition the hardboard to normal humidity before installing it.

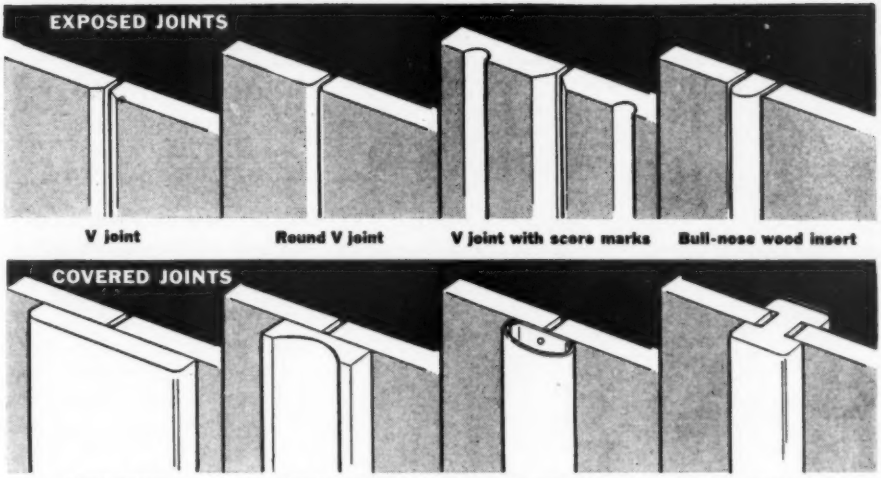
A popular way of minimizing expansion is to condition the panels by allowing them to stand a day or two in the room where they'll be used. Spread out and allowed to stand against the wall, they'll take on the normal moisture content of their new environment and expand to a point where slight changes in the atmosphere will affect them very little. Any additional expansion can be taken care of by leaving a $\frac{1}{16}''$ space between panels and at the top and bottom.

You can even install hardboard in places that are damp all the time, or in such places as laundries, bathrooms, garages and photo darkrooms where humidity ranges from dry to extremely humid. But before you do, expand the panels *to their limit* by scrubbing them with water.

Place them smooth side down on a level surface and, using a brush or broom dipped in cold water, saturate them until their color darkens. Stack them back to back and cover the pile with a tarpaulin or heavy paper for at least 24 hours. Install them before they dry.

Hardboard with two smooth sides requires a different treatment. Place single sheets of newspaper over a panel and drench them with a sprinkler can or hose set for fine spray. Lay the next panel on the saturated paper, cover it with paper and wet it. Repeat this until all the panels are stacked in one big sand-

8 ways to dress up or camouflage open hardboard joints



wich and cover them up for 24 hours.

The safest method of all is to plan the installation with ample spacing at all joints. A good $\frac{1}{16}''$ is plenty and the gap can usually be gauged by using as temporary spacers the same nails with which the material is being applied. Joints can be disguised by beveling meeting edges and scoring additional V grooves at each side of the joint. Joints can be concealed by battens or moldings or by using strip wood inserts between panels.

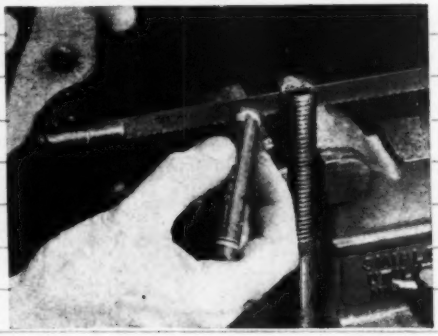
Air circulation also helps minimize expansion. Apply furring strips to hold the panels away from damp masonry walls and cut the strips about 2″ short at each end to avoid creating dead pockets of damp air. Leave a little space between the panels and floor to let air pass under and behind them. END

'Sandwich' Flooring Is a Heating Duct

THE floor becomes a heating duct in this new way to heat homes. Air is forced through a "sandwich" made up of two thin sheets of plywood spaced 1″ apart by fiberboard rings. Heat radiates evenly upward throughout the whole room. For quick heat, additional air is also released directly into the room through small cracks around the floor edges.

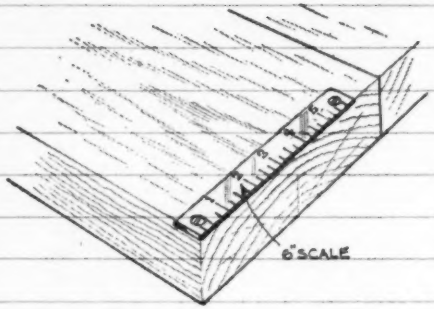
The sandwiches can serve both as subfloors (right) or as interior partitions. Devised by William A. Riehl of North Canton, Ohio, the new system eliminates the cost of conventional ductwork and reduces drafts.

PS Shop Notebook



Hacksawing Stainless Steel

Rub wax or stick grease on the hacksaw blade when you cut stainless steel. It'll save elbow grease. Friction heat melts the lubricant and it spreads to the metal, helping the blade to cut easier. After the job is finished, the lubricant hardens as the metal cools, and is then easy to remove.—*W. E. Burton, Akron, Ohio.*

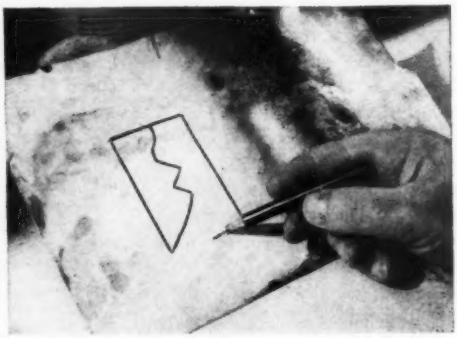


Scale on Bench

Set flush in the edge of a bench, a 6″ scale is never in the way. Yet, it's always handy for checking screw lengths and stock dimensions. Chisel a recess in the bench and fasten the scale with two countersunk wood screws.—*Roger Isetts, Kenosha, Wis.*

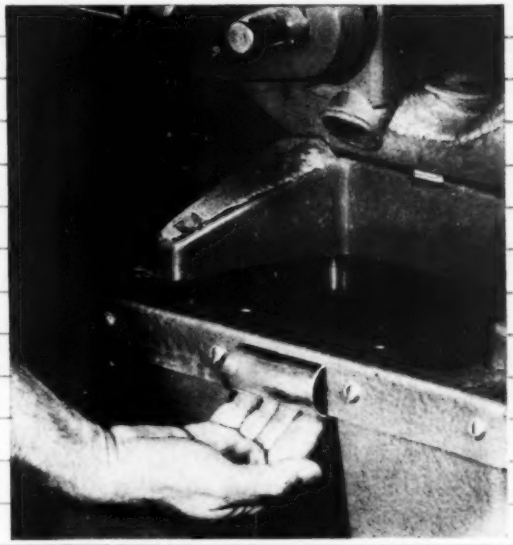
HAVE YOU TRIED THIS?

Draw layouts on metal by wiping the surface with oil and dusting it with white talc. Then use a pencil or pointed stick. If the layout must stand handling, apply the talc over a thin coat of shellac. The shellac can be removed with steel wool.

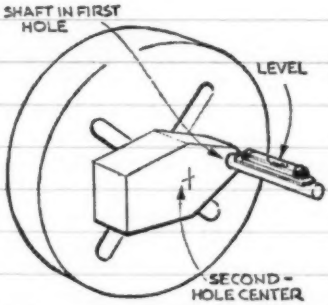


Tool-Stand Handle

Lifting a tool stand by the sharp edges of steel angle is hard on your hands. To make comfortable lifting handles, slit short lengths of aluminum tubing and force them over the angle. Friction holds them in place. Use them in pairs whenever you must move a tool, or fit a permanent set to each stand.



Level Aligns Holes



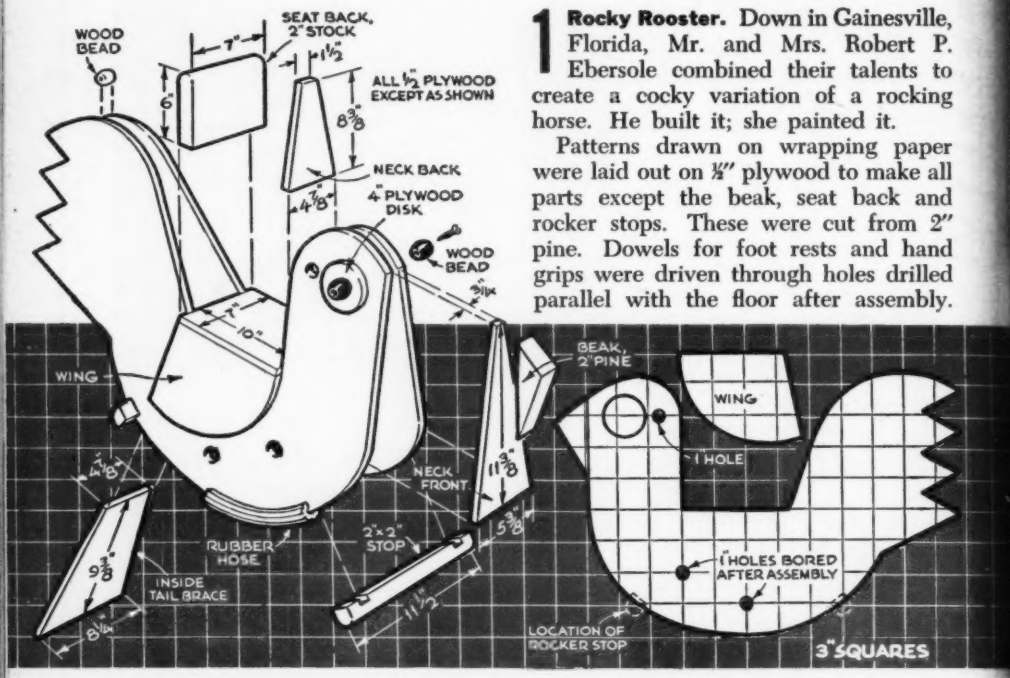
When two holes must be parallel, as with a block that slides on parallel rods, there's an easy way to do the drilling. Drill the first hole carefully, then center the work for drilling the second hole. Make sure the lathe is level, then insert a dowel pin in the first hole and try it with a machinist's level. Adjust the work until the dowel is level in four positions 90° apart, then drill the second hole.—*Federico Strasser, Santiago de Chile.*

The Month's Neatest Trick

I could barely reach the bolt with one finger, much less put a nut and washer on it. It was in one of those inaccessible places where successive steps in assembly all but covered it over, yet it secured a part I had to replace.

Heavy-duty rubber cement did the trick. I cemented the washer to the nut with it, then put a dab on top of the nut and on my fingertip. I picked up nut and washer by contact and held them against the bolt while I turned its head to engage the threads. —*George Walton, Sharonville, Ohio.*

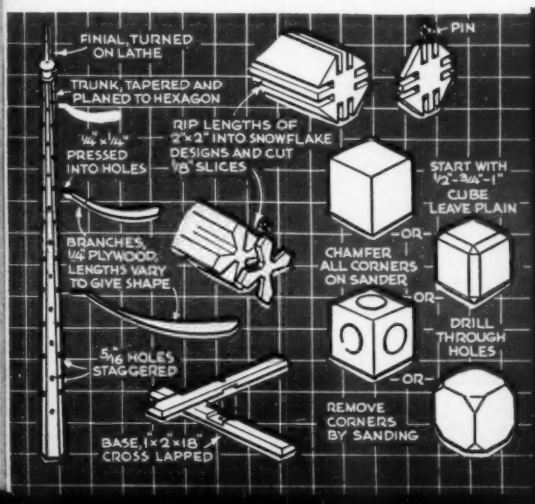
3 Ideas for Christmas



1 Rocky Rooster. Down in Gainesville, Florida, Mr. and Mrs. Robert P. Ebersole combined their talents to create a cocky variation of a rocking horse. He built it; she painted it.

Patterns drawn on wrapping paper were laid out on ½" plywood to make all parts except the beak, seat back and rocker stops. These were cut from 2" pine. Dowels for foot rests and hand grips were driven through holes drilled parallel with the floor after assembly.

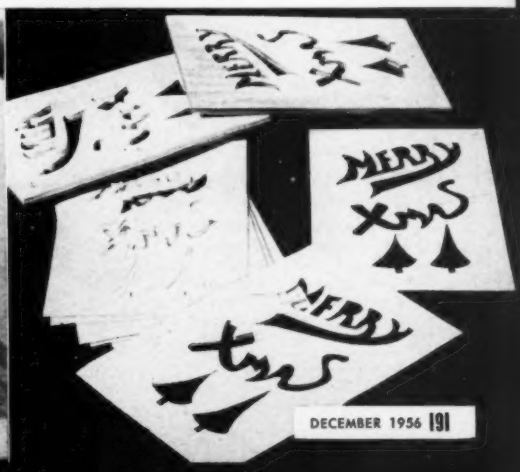
2 Wood Christmas Tree. Tools seldom stand idle in the workshop of R. J. De Cristoforo, of Los Altos, Calif. Last December he turned out a wooden Christmas tree. A length of pine planed to a long tapering hexagon supports branches cut from ¼" plywood. Ornaments were made by ripping lengths of 2" by 2" into snowflake designs and cutting off ⅛" slices. Cubes of scrap also were used. The ornaments were coated with bright enamels and trimmed with sequins, gold and silver paint and colored sawdust. The tree was finished with green plastic snow and the top edges of the branches were sprayed white.



3 Greetings from a Saw. Darrell Huff of Sonoma, Calif., uses a jigsaw to cut out Christmas greetings in quantity. As you see in the photo at right (below), he turns out many complex shapes.

He begins the job by stacking suitable paper between two sheets of plywood, the design being sketched on the top piece of plywood. Nails are then driven through the assembly, the nailing being done where the holes won't show.

A blade suitable for wood makes quick work of the paper-cutting job. If the plan calls for a punched hole for binding or tying, a wood-boring bit in a drill press does the trick.



Handyman Uses for Kitchen Tools

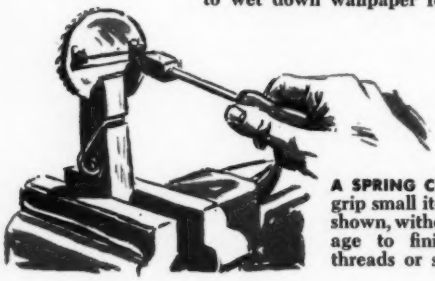
A BEVERAGE CAN OPENER is useful in repairing fine cracks in plaster. Use the point to clean out and enlarge the crack before filling it with the patching material.

A STRING DISH MOP can be used to apply asphalt patching to gutters or a hole in the roof. It spreads the goo around the repaired area quickly and evenly.

A MEAT BASTER is ideal for adding distilled water to a car battery without spilling or waste. It costs considerably less than a hydrometer, too.

A BUG SPRAY GUN can be used to apply sizing to walls and ceilings. Use it, too, to wet down wallpaper for removal.

A RUBBER PLATE SCRAPER makes a good paint-mixing paddle and it's shaped just right for scraping out the last bit of paint from the side and bottom of the can. Cleaned after using, it will last years.



A SPRING CLOTHESPIN will grip small items in a vise as shown, without risk of damage to finished surfaces, threads or sharp edges.

Space and money-saving facts about

The Roof That Lets You Push Walls Around

By Sheldon M. Gallager

A TRUSS roof is the nearest thing to hanging the top of your house from sky hooks. This self-supporting, postwar design now makes it possible to span the entire width of a house without beams or interior partitions to help hold it up. A truss roof holds itself up.

Why should you want to know about a roof like this? Because . . .

• You may be living under one now. This means that any dream of knocking out a wall to make more space can easily come true. Or perhaps you want to cut an opening for a door, kitchen pass-through, or TV niche. If so, go ahead and saw away the wall studs—in interior partitions only—and nail in light trim boards. Heavy load-bearing headers and framing aren't necessary.

• If your present home doesn't have a truss roof, the chances are good that your next one

Old-type roof (below) rests on lengthwise partition that usually can't be removed. Only crosswise partitions (in white) can be taken out.

will. Planning it will be easier. Conventional joist-and-rafter construction requires a center row of partitions that automatically limit the size and arrangement of rooms. A truss roof doesn't. You can place your partitions wherever you happen to want them.

In some areas, you may want to put up light storage walls, folding dividers or the modern ¾-high partitions that give a feeling of greater spaciousness. You can do these things, too. A double-car garage is also a good candidate for a truss roof, since you can span the full width without a heavy center beam and lally columns to get in the way.

How to tell if you have one. If your attic looks like a

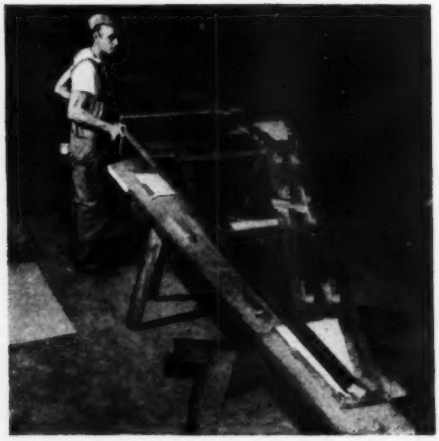
"W" truss at left below is most common type, spans widest roofs. Scissors truss at center is used on shorter spans, but provides a higher ceiling. Rare truss at right has attic space, but must be well built to take load.

forest of angular uprights, you've got a truss roof. These are the diagonal braces that give the truss its strength.

However, most truss roofs aren't designed for attic space. If you can't get in, this may be a tip-off. Try to peer in through an air vent with a flashlight. Another tip-off may be the spacing of nails around the edge of the roof or in a ceiling. If the nails are 24″ apart, instead of 16″, the roof is probably a truss.

If you're in doubt, it's best to have a builder or architect take a look. Some semi-truss designs rest partly on partitions and may not permit your knocking out a wall willy-nilly. Partitions that run in the same direction as the ceiling joists can usually be removed safely, sometimes even under a conventional roof. Those that run at right angles to the joists may be load-bearing and should be approached with care.

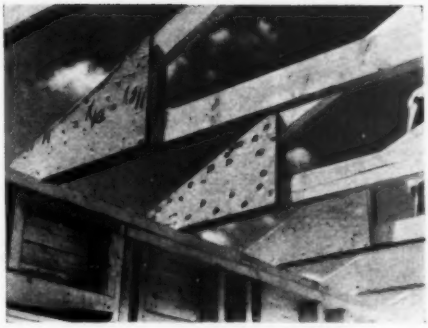
Parts for truss are laid out in this full-size jig, then are spliced together at joints with plywood gusset plates.



What's a truss, anyhow? You've seen them many times on bridges and other structures—web-like members criss-crossed with diagonal braces. Small-scale versions of these are well suited to today's low ranch-type houses where attic space isn't available anyway.

Trusses work on a very simple princi-

ple: a piece of wood (or steel) is far stronger when it's being pushed or pulled lengthwise than when it's being bent sideways. In a truss, the diagonal braces take the main brunt of the load on their *ends* and thus prevent the other members from sagging.



Trusses are nailed to top of sidewalls like ordinary joists. Roof boards nailed across them then tie them into a single, rigid unit without need for a heavy ridgepole.

One of the most popular designs is called the "W" truss because the diagonal braces form a W between the rafters and the joists. Exact dimensions vary, but roughly the top three points of the W join the "peak" of the truss and the midpoints of the two rafters. The two lower points join the joist one-third of the way in from each end.

Trusses save you money, too. Because you can space them 2′ apart, instead of every 16″ as in conventional construction, this means that for every 4′ of roof length, you need only two trusses, but three pairs of rafters and joists.

For spans up to 24′, most trusses can be made of light two-by-four lumber. For longer spans, the rafters are usually two-by-sixes, but the rest of the truss still uses two-by-fours. In some, the cross braces are even 1″ lumber, instead of 2″.

You also get a stiffer roof that won't sag as much and crack ceiling plaster. It will withstand snow loads and years of weather torture without getting a sway-back look.

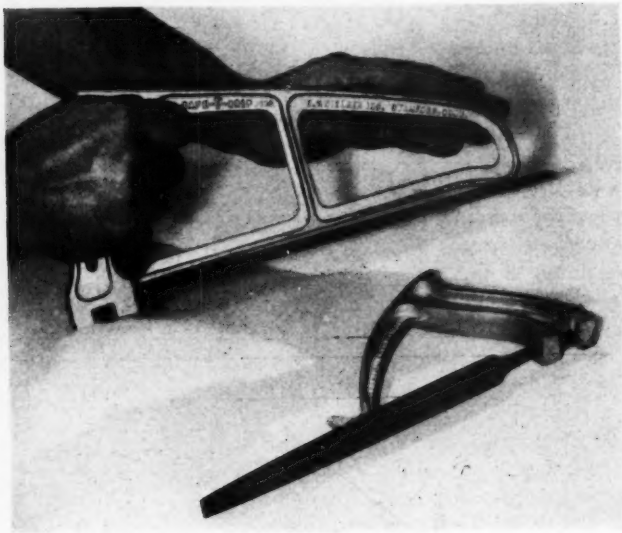
Controversy. Right now, builders are arguing over the best way to put roof trusses together—with nails or glue. In nailing, the parts are overlapped and side-nailed together. In gluing, they are cut to a butt fit, and the joints are spliced with glued plywood gusset plates.

The pro-glue people claim that nails can pull out, while glue will hold even after the wood has failed. Nail proponents argue that it's hard to keep the glue fresh and the wood clean for a good bond, and that the plywood gussets are costly to cut. Both sides agree that nails-plus-glue give the strongest construction.

End trusses go up completely finished with shingles, air vents and trim already on. On some jobs, the trusses are fitted into metal brackets nailed to the walls to speed spacing and alignment.

Whatever the method, one thing is sure. Tests conducted by the U. S. Forest Products Laboratory, the University of Illinois, and the Virginia Polytechnic Institute prove that roof trusses are a hefty hunk of construction, indeed. You could do well to put them to work for you. END

New Tools



1. Handle for Files. When a file is held with either of these double-support grips, you get the working convenience of a plane and can use all the cutting area. Made of aluminum, the large holder (top) takes heavy production-type files; the smaller one, standard sizes. To attach, you run the file's tang through two holes in the handle, then tap the other end. A light tap will remove the file for a change.

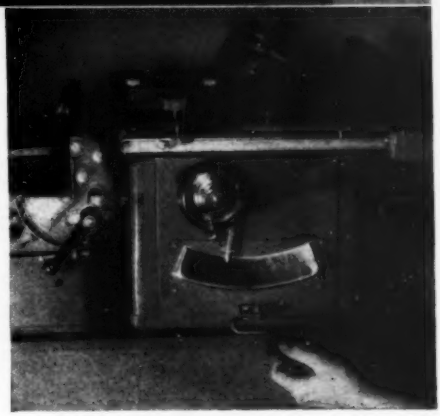
2. Pliers Can't Mar Chrome. Because its jaws have no teeth, this version of slip-joint pliers (left) lessens the risk of gouging chrome-plated fittings and other smooth-surfaced materials. Interlocking channels let you adjust the jaws through five non-slipping positions to get a choice of openings from ⅞″ to 2″.

3. Screwdriver Prevents Blisters. When this screwdriver is turned, there is no friction to rasp the palm of your hand. The top is a metal cap loosely attached with a pin. It remains stationary against your palm while you turn the driver.

More information *about the products shown on these pages can be obtained from: 1. E. V. Nielsen, Inc., 132 Broad St., Stamford, Conn.; 2. Champion DeArment Tool Co., Meadville, Pa.; 3. O'Reilly Tool Co., 205 W. 19th St., New York City 11; 4. Delta Power Tool Division, 462 N. Lexington Ave., Pittsburgh 8, Pa.*

4. New 9″ Table Saw. Delta is now making a saw to bridge the gap between the 8″ home-shop size and the larger industrial or construction models. Besides the extra inch of cutting capacity, it features (at right) a raised tilt scale that is easy to read and a switch you can padlock to prevent unauthorized use.

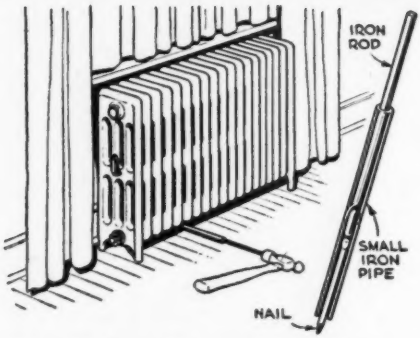
You can buy the saw separately and add other tools to make full use of the motor. These include a 4″ jointer, disk sander and drill press, all designed to attach to the saw or stand, and take power from the motor or a pulley that replaces the saw blade on the arbor.



Straps Over Wheelbarrow Provide Safer Ride for Firewood

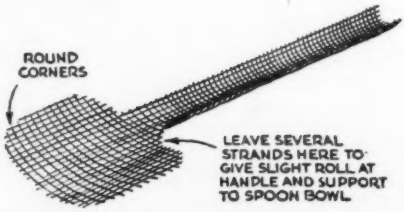
STOCKING up on wood for a fireplace goes faster if you add straps to your wheelbarrow so that it can carry big loads over bumpy ground without spilling. Nail the straps, front and back, to the beams of a wooden barrow. If the pan is metal, bolt straps under it near the edge.—*J. Burroughs, Tacoma, Wash.*

▶▶▶MOISTURE in wood framing around windows and doorways of a new home may crack nearby plaster. My plasterer friend says his carpenters prevent this with aluminum foil. The foil is stapled to overlap the framing before plastering up to the wood.—*Ed Frazer, Kewanee, Ill.*



Pipe Drives Nail in Tight Spot

THIS holder helps you nail a hard-to-reach spot, such as molding behind a radiator. Slip one end of a small pipe around the nail to position it. Then drive in the nail with an iron rod tapped through the pipe from the other end.



Screen Spoon Skims Lead

IF YOU melt small amounts of scrap lead, here is a quick spoon for skimming dross off the hot liquid. Snip a strip of window screening 1¼″ wide and 6″ long. Cut this to the shape of a paddle with a handle 4½″ long and ⅜″ wide. Round the corners to make a "bowl." Skimming quickly, the handle stays cool enough to hold, or you could wrap it with cloth. —*Charles Hardy, Whittier, Calif.*

Tape Rolled for Neater Masking

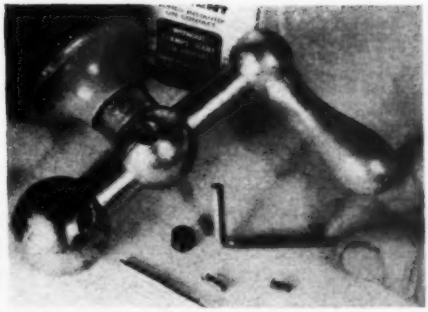
WHEN using masking tape, make sure its edges stick tightly, or paint will leak under them to spoil a neat job. Pressing the tape with a furniture caster will seal down the edges effectively.

Blank TV? Try Switching Tubes

WHEN I lost my TV picture one Sunday afternoon, a little tube swapping brought it back. I had no extra tubes, but I checked those in the picture circuits and found all filaments glowing. Since a tube that won't work in one circuit often works in another, I looked for all the duplicate tubes I could find. Then I disconnected the set and switched identical tubes, turning the set on after each switch. Three tries and I had a picture.—*John H. Dozier Jr., Pine Bluff, Ark.*

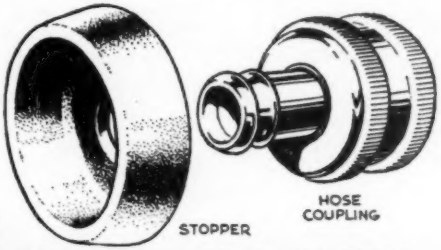
Deposits Clog Faucet Strainer

FAUCET strainers need periodic cleaning to remove rust and scale. If they won't spin off easily with your fingers, pad the jaws of a small wrench to unscrew them. Reassemble the parts carefully so that the splash-preventing action of the strainer won't be hindered.



Solder Tightens Setscrews

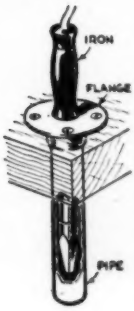
WHEN vibration loosens an Allen-head setscrew, you can make it hold by cushioning the end with a drop of solder in the hole. (Use plain, not acid-core, solder.) For extra grip, add a touch of glue before you put the screw back in.—*C. C. Cooley, New Buffalo, Mich.*



Water Pressure Clears Drain

IF A plumber's snake is too short to clear a clogged drain, try this. Cut a hole in a rubber sink stopper to take the ferrule of a female hose coupling. Insert the stopper in the drain, connect the hose, and run water full force until the drain is open.—*R. L. Ellis, Miami Beach.*

Pipe Holds Hot Soldering Iron



YOU can store a hot soldering iron safely out of the way by dropping it in this pipe holder set in the workbench. Bore a hole in the bench to take the neck of a floor flange, and mount the flange upside down. A length of pipe to house the iron is screwed into the flange from beneath.—*H. Moody, Upper Jay, N. Y.*

Three Ways to True Worn Lathe Chucks

AFTER long use, universal lathe chucks commonly develop two faults. Bellmouth, a spreading of the outer ends of the jaws, is due to wear from gripping short pieces of work. Eccentricity is caused by wear in the scroll, jaw teeth, and jaw ways.

Accuracy can be restored by grinding the inner jaw faces. But this must be done with pressure applied to the jaws exactly as when they are holding work, so as to take up all slack in the clamping mechanism. Here's how to do it:

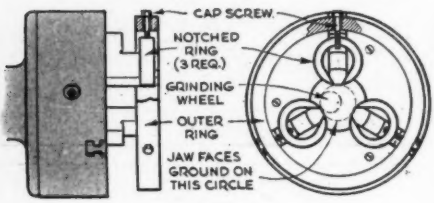


FIG. 1

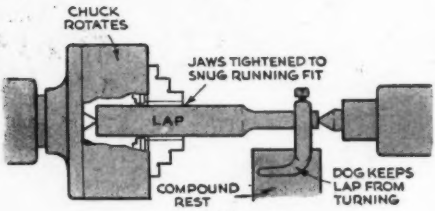


FIG. 2

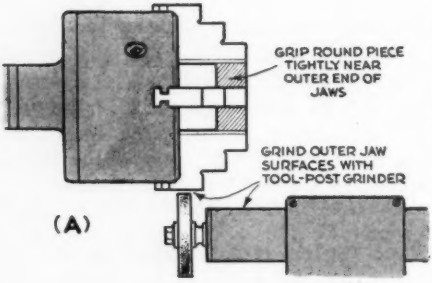
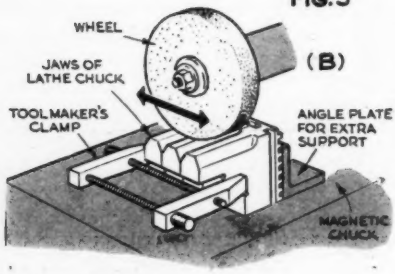


FIG. 3



1 GRIPPING RINGS simulate work pressure while leaving the jaws free for grinding. Drill three holes 120° apart in a steel ring almost as large as the chuck body. Notch three small rings to fit over the tapered jaw ends as shown, and tap each for a small cap screw opposite the notch. Mark the chuck-key hole that is used to tighten the jaws against the rings. With the lathe running, grind the jaws with a tool-post grinder. For greater accuracy, use the marked keyhole thereafter to tighten work.

2 LAPPING THE JAWS will correct very slight inaccuracy or bellmouth. Turn a bar of brass or cast iron true between centers. Mount the chuck, and replace the lap on centers with a dog bearing on the compound rest to keep the lap from turning. Coat it with medium to coarse abrasive, tighten the jaws snugly on it, and start the lathe. Keep tightening the jaws, adding fresh abrasive and oil as necessary. When the lap scores, remove it and true up again. Clean all compound off when finished.

3 REVERSE ENGLISH can be used to true a chuck if both a tool-post and a surface grinder are available. Grip a piece of perfectly round stock tightly near the outer ends of the jaw. Permanently mark the chuck-key hole used. With the chuck turning, grind the outer surfaces of the jaws as at *A*.

Remove the jaws and clamp them together on the surface grinder with the ground surfaces on the magnetic chuck as at *B*. Then grind across the top. Use the marked keyhole for precision work.

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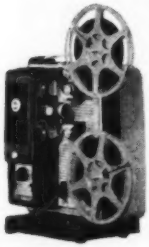

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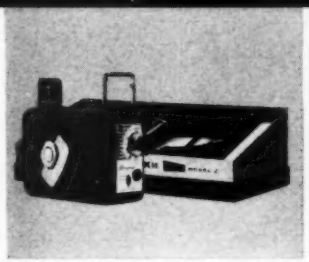

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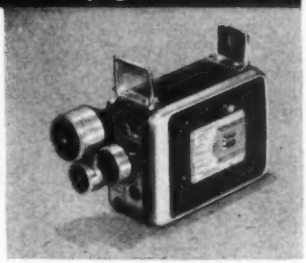
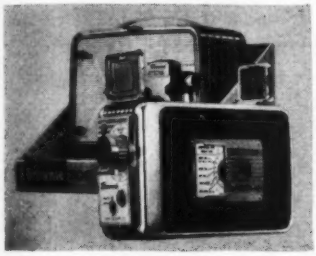


Brownie Movie Camera, Turret *f*/1.9, gives you 3-lens versatility at a 1-lens price! Takes regular, wide-angle, and telephoto movies *in full color*. Only one easy setting to make, then aim 'n shoot. It's just as easy as taking snapshots. Only **$79.50**



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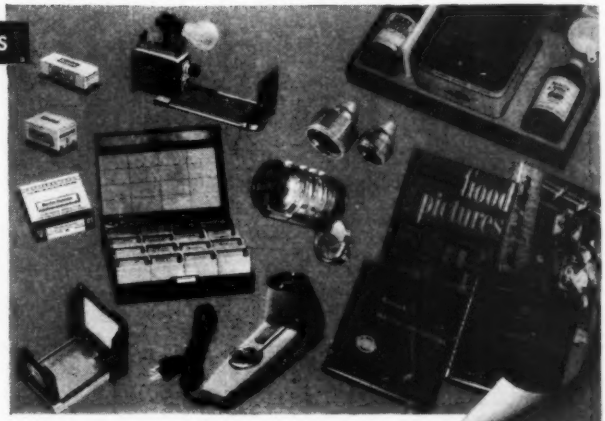

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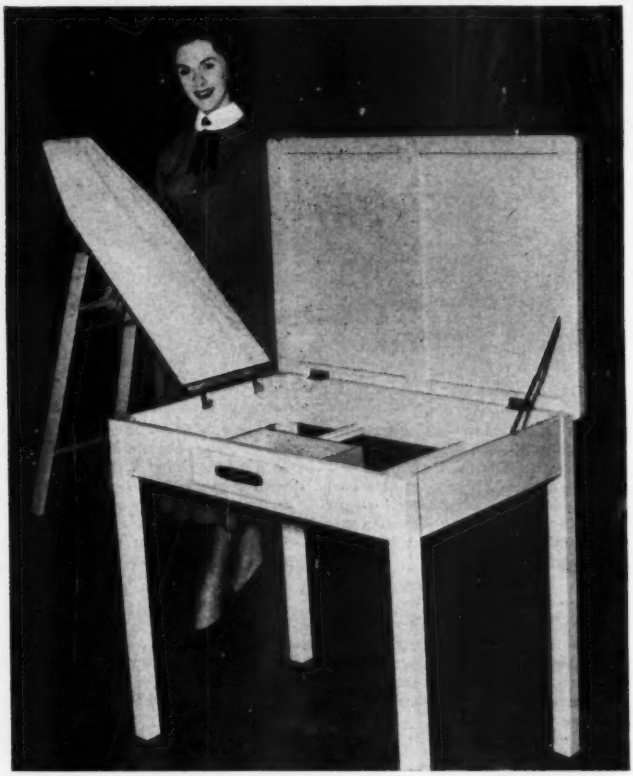
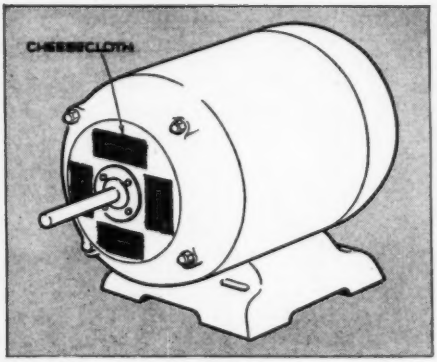
Folding Ironing Board Tucks Away Under Kitchen-Table Top



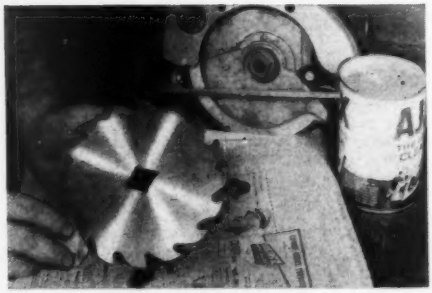
THIS combination kitchen table and ironing board was shown recently at a British furniture exhibit. The space-saving design has a hinged top on a simple table base and a hinged ironing board that fits between the end aprons. The ladder-like prop supports the end of the board when it is in use and folds away when the board is stored.

▶▶▶The old dodge of using a nail for drilling into plaster is a good one also for drilling exactly sized pilot holes in wood. Cut the head off a nail of the same size that you will use, and chuck it in drill.—*Guy Holmes, Crystal Lake, Ill.*



Cheesecloth Protects Motors

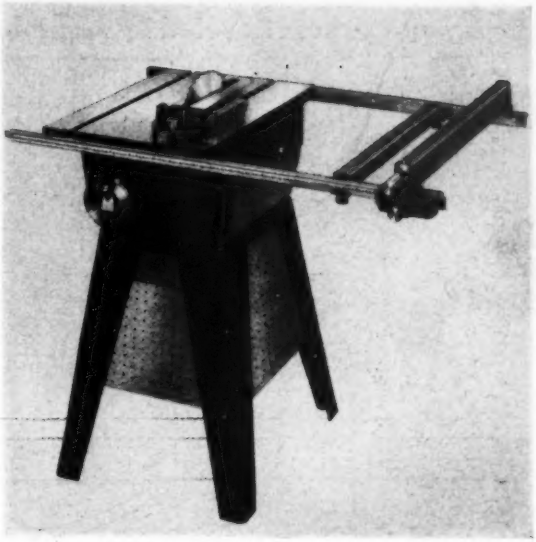
YOUR shop motor will operate better if chips and other particles are not allowed to get inside. Strips of cheesecloth cemented over the vents do the job. —*Edward Thaddeus, Sacramento, Calif.*



How to Clean a Saw Blade

PITCH and tar accumulating on a saw blade will gum up the teeth, heat them up fast and slow down work. You can prevent this by removing the resin with scouring powder, the same kind that your wife uses on pots and pans. Before you put the blade away, rub on a coat of furniture wax to keep it from rusting.

New! MAGNA offers America's finest tilt arbor saw!



MAGNA 9-in. Saw with "The Helping Hand"

The Magna 9-in. Saw is the only tilt arbor saw with "The Helping Hand"—a built-in extension which makes the largest (34" x 24") effective table on the market—gives you bigger rip and cross-cut capacity than even 10-in. saws! Check these important features: Epicyclic Speed-gear Control gives you full 45° tilt with only 10 turns of knob (40 to 60 turns on other saws!) • Single-knob Control—push for blade height, pull for tilt • Self-aligning Fence locks both front and back with single knob • Externally adjustable Tilt Stops, easy to reach • Colored Safety Zone Table Insert cannot catch work piece • Exclusive pressure-cast tub front bolted rigidly to table, coordinates all controls • 3 Auto-stops on Miter Gauge • Inter-change Arbor for quick change of blades • Constant belt tension at any degree of tilt • Easily converted to largest capacity saw-jointer (operates at any height of blade) with Magna 4-in. Jointer and the inexpensive Magna Saw-Jointer Adaptor Kit!

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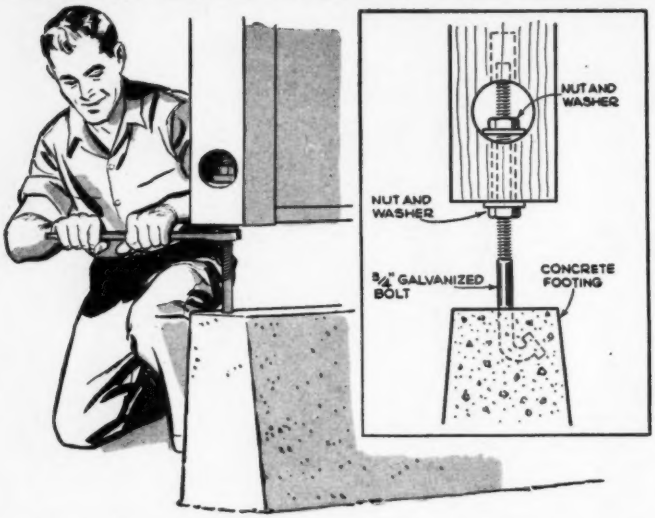
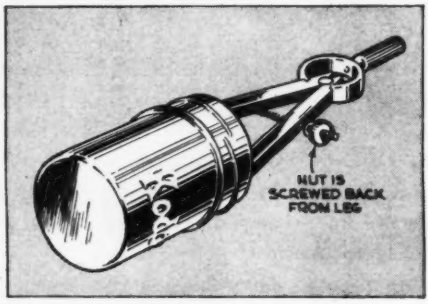
Sagging Carport Leveled by Adjustment with Built-In Jacks

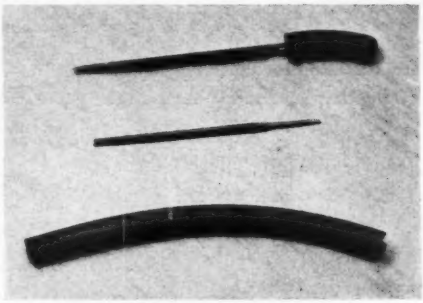


WHEN I built my carport I knew that the footings might settle, so I built in jacks that would keep the posts adjusted. The jacks are simply ¾" galvanized bolts which I bent and imbedded in each concrete footing. Their ends were then inserted in the posts, which had been cross-bored, as shown in the drawing, to allow adjustment of anchoring nuts.—*J. Thompson, Chincoteague, Va.*



Film Tube Guards Divider Tips

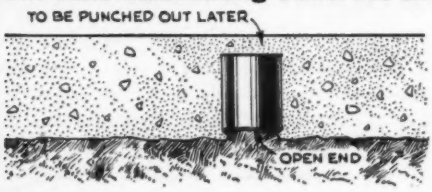
YOU can protect the points of dividers by encasing them in a tubular film container or a medicinal-tablet vial before you put the instrument in the tool box. Open the dividers wider than the container and compress the legs to insert them. To keep them under tension, it is best to spin the nut away from the leg.—*Frank La Saracina, NYC.*



Tubing Puts Grip on Files

THICK-WALLED rubber tubing, used in machine shops for shock-absorbing mounts and rubber rollers, makes good nonslip handles for files. If you can't find it in your hardware store, try a machine-shop supply house. Cut it to the lengths needed, and push it over the tangs. For large files, you may have to ream the hole. —*Theodore Wirbisky, Shenandoah, Pa.*

Tin Cans Sunk Along Concrete Drive Form Postholes for Fence



WHEN you build a new driveway, you can provide for a fence you may want later. Sink tin cans, open end down, along the edge while laying the concrete. Mark each with an X scratched in the wet mix. When you want postholes, just punch out the tops with a crowbar.

Carl Kiekhaefer gets more power from his Chrysler-built cars with 5-rib Champion spark plugs. He's shown here with two of his big racing winners and part of his remarkable trophy collection

Big winner in stock car racing uses Champion spark plugs!

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Carl Kiekhaefer and his drivers—one of the winningest teams in stock car racing history—know this well. That's why they use Champions in all their record-smashing Chrysler-built cars. (What's more, Mr. Kiekhaefer uses Champions in every single one of his famous Mercury Outboard Motors.)

And here's an important tip for you! Tests show that if you've gone about 10,000 miles without a spark plug change, new Champions can give you an immediate gain in road horsepower. All major makes of cars were tested—*and the average gain was 24%!*

Replace your old plugs with Champions today—and you'll feel the difference *at once!*

CHAMPION

LOOK FOR THE 5 RIBS

New Powerfire electrode stands up better. Photo shows how ordinary electrode (*left*) burns away. Champion's Powerfire electrode (*right*), after identical use, is still good for many miles of powerful, full-firing performance.

[*Continued from page 144*]

"Try her now," he said, when the plugs were replaced.

Erickson turned her over. The engine caught. As it revved up, Gus detected a high-pitched, familiar whine. He brought his hand down sharply. "Cut!" he yelled.

Knute Hansen, who had sprung for the fuselage the moment the motor started, halted in mid-stride, swiveling about to look at Gus with an agonized expression.

"It's all right, Knute," Gus assured him. "The starter clutch didn't disengage—caused by the cold, probably. Try again, Erickson."

This time when Erickson engaged the starter switch the engine didn't budge. The starter seemed completely dead.

"What's wrong now?" Gus said anxiously. "Is there any way of starting this rig without the starter?"

"Not a chance," the pilot told him. "It's the starter, or nothing."

Gus quickly checked the starter cable and switch, looking for loose connections. Then he removed the starter, laid it down on the floor of the fuselage and started to take it apart.

LOOKING down at the damage, Gus stood there with the snowflakes whitening his shoulders, wondering how long it would take them to fight 20 miles through the snow to Highland afoot, and bring back a pain-racked child to his truck.

When the copter's starter had failed to disengage, the engine had spun the armature so fast that one of the windings had been thrown from the armature core slot by centrifugal force. The winding, a piece of copper about a sixteenth inch wide by an eighth of an inch in depth, had become locked between the armature laminations and the field-coil pole shoes. It had been broken in two, twisted around, flattened to knife-blade thinness.

"We're sunk," Erickson said woodenly.

"By yimminy, maybe I better start walking," Knute Hansen said. Looking into the old man's eyes Gus saw the rising panic there, and something else—a question.

"I don't know, Knute," Gus said slowly. "You see, I don't know just how much damage has been done here."

"Lay off it," Erickson said sharply. "Tell him the truth. You know as well as I do that this starter is completely shot."

"Maybe," Gus said shortly, and with a pair of side cutters he neatly snipped off the broken ends of the armature winding, tapped the stub ends down into the armature core slot, so that they wouldn't strike the field coils. He assembled the starter, with the armature carefully set in a certain position in relation to the brushes.

"Try her now, Erickson," he said.

AN EXPRESSION of surprise came over the pilot's face as the engine turned over, and then caught. The long rotor blades over Gus's head turned slowly in negative pitch. Knute Hansen tumbled into his seat.

"If you manage to get off," Gus yelled, cupping his hands, "don't stop that engine in Highland. It won't start again if that starter happens to stop on the dead commutator bar."

The rotor began to revolve faster. The squat, ugly machine began to rock in the snow, and Erickson gave her full throttle. The helicopter lifted, rose above the trees, its down-wash temporarily blinding Gus with blown whiteness. When his sight cleared he could dimly see the machine in the storm, high in the wintry sky, lined out on a course for Highland.

Gus trudged back to his truck and headed back for town. This was one service call that would have to wait. Then he smiled to himself. If all went well, he was thinking, little Inga would be back home again in time for the Christmas holiday. END

NEXT MONTH: Gus tames a grease monkey.

Texaco Tips On Car Care

For greater driving safety

have your car's underside checked carefully for holes in the tail pipe or muffler caused by rust or corrosion. If any exist, combustion fumes can seep into your car—and that's particularly dangerous in winter when you often drive with all windows closed. Your nearby Texaco Dealer will gladly make this check for you.

For a cleaner, livelier engine...

use Texaco's amazing new motor oil—*Havoline Special 10W-30*. It's light for quick cold starts, yet has body to protect against engine heat. In any season, it assures clean, power-packed performance . . . added gasoline mileage. So change now and change regularly to *Havoline Special 10W-30*. It's the motor oil that thinks for itself . . . saves you thinking about seasonal grades. Get it from your Texaco Dealer, *the best friend your car has ever had.*

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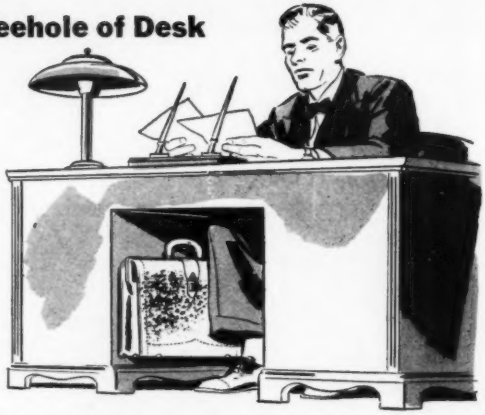
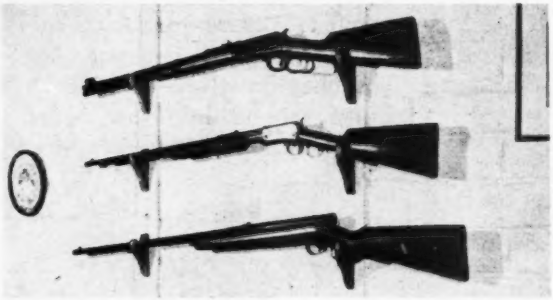
Briefcase Hangs Inside Kneehole of Desk

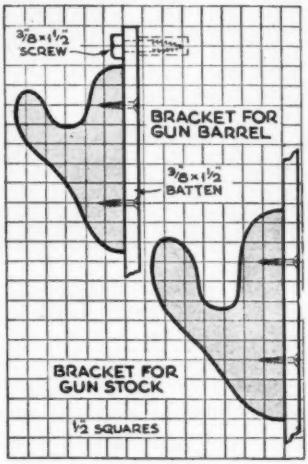


IF YOU don't want to dirty a briefcase on the floor, or rob valuable desktop space for it, screw a large cup hook on an inside wall of the desk's kneehole. This holder will keep it handily out of the way.—*R. M. Woodbury, Natick, Mass.*

▶▶▶TO PREVENT children from poking into trouble, don't allow light sockets to remain empty indoors or out. When a bulb is removed, insert a burned-out fuse plug. That will keep shock out of finger reach.

Gun Rack Mounted on Wall Strips Can Be Made to Any Size





THIS frameless gun rack is quick to make, lets you adjust spacing to suit different rifles, and can be enlarged as your collection grows. Two ¾″ hardwood brackets are cut out for each gun, then screwed to batten strips. The battens are then screwed to the wall at the right distance, in this case 21″ apart.

Hose Clamp Protects Fingers While Hammering on a Chisel

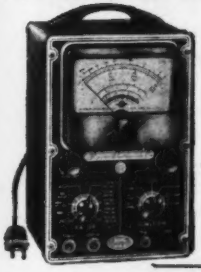
IN A spot where your fingers might be in danger, a hose clamp will make a safe holder while hammering a chisel. Tighten the clamp around the chisel's shank, and the protruding end of the band acts as a handle. You can lengthen this handle if you like by pressing one end of a 6″ length of ½″ tubing over the protruding end of the clamp and hammering flat.

▶▶▶A PAIR of truck clearance lights will give your child's pedal car real headlights. Use the white flush-mount type and wire them to a 6-volt lantern battery and switch mounted below the "dashboard." A red light will make a taillight.

FOR REPAIRING RADIO AND TV

Superior's New Model 670-A

SUPER METER



A COMBINATION

VOLT-OHM MILLIAMMETER PLUS CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.

ADDED FEATURE:

Built in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers.)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: −6 to +18 +14 to +38 +34 to +58

The Model 670-A comes housed, in a rugged crackle-finished steel cabinet complete with test leads and operating instructions.

28.40

Superior's New Streamlined Model TC-55

TUBE TESTER

QUICKLY AND EFFICIENTLY TESTS RADIO AND TV TUBES INCLUDING: SEVEN PIN MINIATURES; EIGHT PIN SUBMINARS, OCTALS AND LOCTALS; NINE PIN NOVALS

YOU CAN'T INSERT A TUBE IN THE WRONG SOCKET. It is impossible to insert the tube in the wrong socket when using the new Model TC-55. Separate sockets are used, one for each type of tube base. If the tube fits in the socket it can be tested.

"FREE-POINT" ELEMENT SWITCHING SYSTEM. The Model TC-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap."

CHECKS FOR SHORTS AND LEAKAGES BETWEEN ALL ELEMENTS. The Model TC-55 provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.

ELEMENTAL SWITCHES ARE NUMBERED IN STRICT ACCORDANCE WITH R.M.A. SPECIFICATION.

One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

The Model TC-55 comes complete with operating instructions and charts. Use it on the bench—use it for field calls. A streamlined carrying case, included at no extra charge, accommodates the tester and book of instructions.

26.95

FOR REPAIRING ALL ELECTRICAL APPLIANCES MOTORS AND AUTOMOBILES

Superior's New Model 70 UTILITY TESTER®

As an electrical trouble shooter the Model-70:

- Measures A.C. and D.C. Voltages, A.C. and D.C. Current, Resistances, Leakage, etc.
- Will measure current consumption while the appliance under test is in operation.
- Incorporates a sensitive direct-reading resistance range which will measure all resistances commonly used in electrical appliances, motors, etc.
- Leakage detecting circuit will indicate continuity from zero ohms to 5 megohms (5,000,000 ohms).
  - Will test Toasters, Irons, Broilers, Heating Pads, Clocks, Fans, Vacuum Cleaners, Refrigerators, Lamps, Fluorescents, Fans, Switches, Thermostats, etc.

As an Automotive Tester the Model 70 will test:

● Both 6 Volt and 12 Volt Storage Batteries ● Generators ● Starters ● Distributors ● Ignition Coils ● Regulators ● Relays ● Circuit Breakers ● Cigarette Lighters ● Stop Lights ● Condensers ● Directional Signal Systems ● All Lamps and Bulbs ● Fuses ● Heating Systems ● Horns ● Also will locate poor grounds, breaks in wiring, poor connections, etc.

Handsome round-cornered molded bakelite case, 3½"x5⅞"x2¼". Complete with all test leads. Also included is a 64 page book giving detailed instructions for testing all electrical appliances, automotive equipment, etc. Only **15.85**

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Try any of the above instruments for 10 days before you buy. If completely satisfied then send down payment and pay balance as indicated on coupon. **No Interest or Finance Charges Added!** If not completely satisfied return unit to us, no explanation necessary.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-308, 3849 Tenth Ave., New York 34, N.Y.
Please send me the units checked. I agree to pay down payment within 10 days and to pay the monthly balance as shown. It is understood there will be no finance or interest charges added. It is further understood that should I fail to make payments when due, the full unpaid balance shall become immediately due and payable.

Name.....
Address.....
City.....Zone.....State.....

All prices net, F.O.B., N.Y.C.

☐ Model 70 . . . Total $15.85 $3.85 within 10 days. Balance $4.00 monthly for 3 months.

☐ Model 670-A. Total $28.40 $7.40 within 10 days. Balance $3.50 monthly for 6 months.

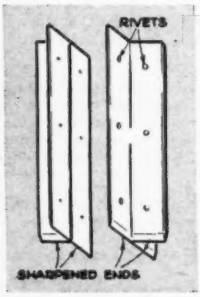
☐ Model TC-55. Total $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.

"Endless" Paper Pad Rolls Out Shop Sketches Neatly

You can keep pencil work at your shop bench under neat control with a roll-out sketch pad. Attach two angle brackets near one end of a wood base, set far enough apart to take a roll of wrapping or shelving paper. A bolt through each angle will hold the roll in place. Fasten down two metal strips (hacksaw blades or tin-can stock are fine) to hold the paper flat.—*C. H. Willey, Concord, N. H.*

One Blow Splits Log Four Ways

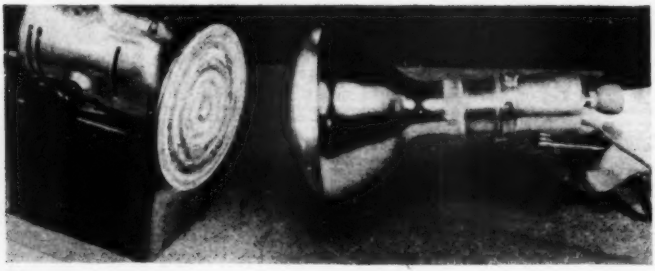
A woodpile will climb faster with this four-way cutter for splitting logs. It is made of four 9" lengths of angle iron, sharpened at one end. They are joined back-to-back with rivets in countersunk holes. When placed on a log end, one blow quarters the wood.—*G. H. Holden, Chesterfield, England.*



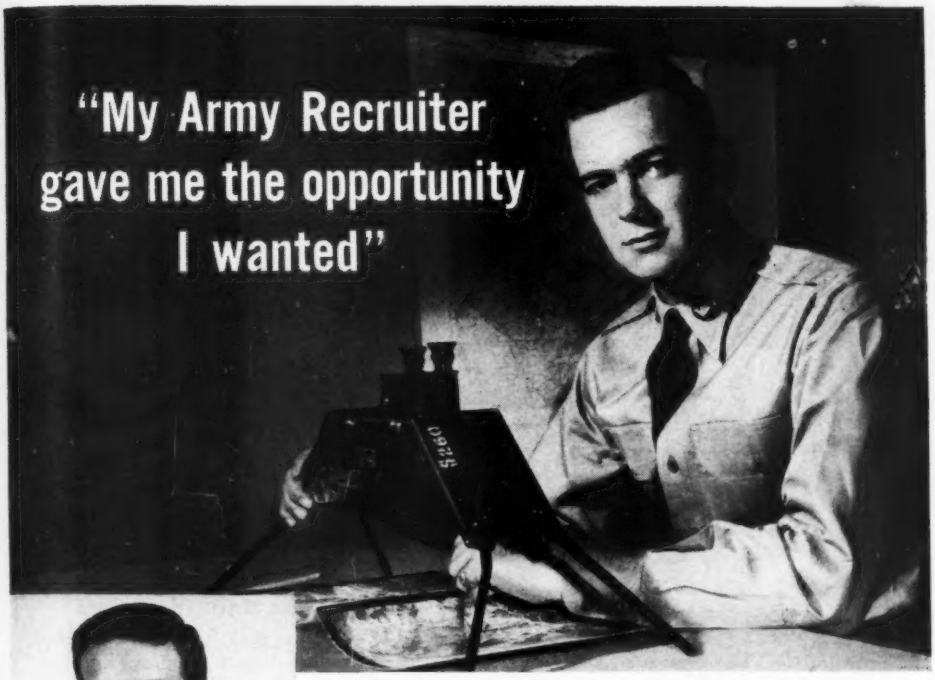
Bracket Guards Tool Switch

I equipped my power-tool switches with a safety guard similar to those now on some new models. The guard is a U-shaped bracket that fits under the nut on the switch. You can flip the toggle to "off" easily, but to turn it on you must reach between the bracket's ears.—*L. E. Johnston, Madison, Wis.*

Pre-Heated Sanding Plate Makes Disks Really Stay Stuck



Before cementing sandpaper to a disk sander, warm up its cold faceplate with a heat lamp. This assures good adhesion so the paper won't peel off in use. —*Ken Hadenfeldt, Storm Lake, Iowa.*



SFC. Joel R. Ledford
Army Recruiter
Marion, North Carolina

..."he showed me how to choose my job training before enlistment"

"I really shopped around before deciding how to serve, and only the Army would guarantee that I'd get the training I wanted. My Army Recruiter was a real friendly guy and showed me how the Army lets you pick your own technical course. And you don't have to enlist until you get a written guarantee that your course is there for you. Now I'm becoming an expert in cartography and will be able to step into a specialist's job. Whatever you're interested in, you can bet the Army has a course in it. You just can't beat the deal the Army offers you. Your recruiter can fix it up for *you*, too. He's a mighty good man to get to know."

Pvt William H. Poteat Jr.

Pvt. William Poteat, Jr.
Marion, North Carolina
Graduate, Glenwood High School

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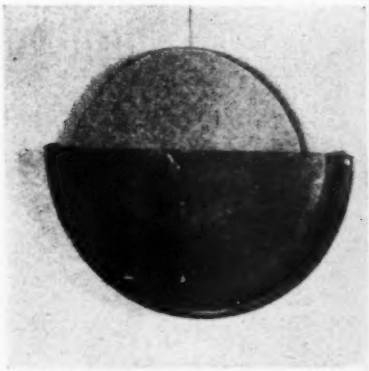
You can get the same deal Bill got by visiting *your* local Army Recruiter. He'll tell you about the 100 courses to choose from—electronics, engineering, medicine, finance, mechanics—just about everything. When you select your course, your recruiter will get you a written guarantee that a place in class is waiting for you. And not until after high school graduation do you actually enlist. So get in on this program right now and prepare for a great future. Just see your Army Recruiter and reserve the course of your choice—at no obligation!

Get choice, not chance, from your Army Recruiter

Sawhorse Pocket Keeps Saw Handy

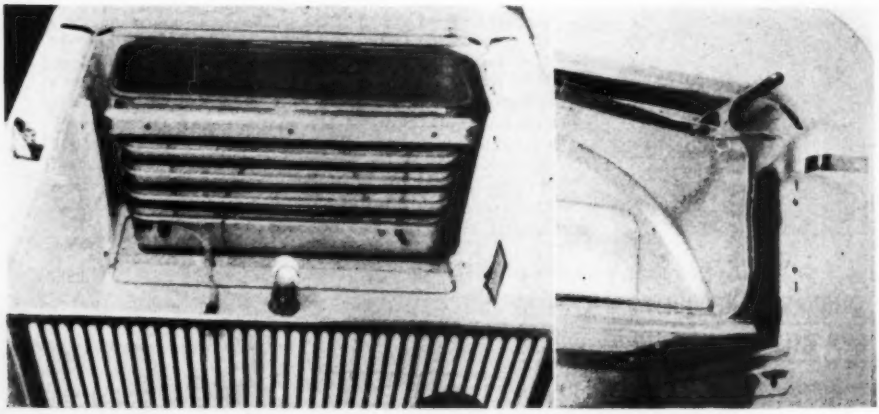
WHEN cutting quantities of lumber on a sawhorse, it is convenient to have your saw in a place where you can reach it. The wooden pocket nailed on the horse in the drawing does just that. A cleat on the bottom keeps the saw tip off the floor.



Rack Holds Sanding Disks

HALF of a cake tin on the wall of your workshop will make a handy rack for sanding disks. Fasten the tin to the wall with small nails driven through the tin's lip.

▶▶▶To patch plastic hose, clean and wrap area with two turns of plastic electrical tape. Then lay a small flat stick over patch and bind on more tape to keep break from twisting.



Heat Tape Placed Around Freezer Unit Defrosts Refrigerator

DEFROSTING is easier if you wind electric heat tape around the refrigerator freezer chamber. Install when the unit is frost-free, clamping tape (right) while you put in permanent clips. To use, plug into the light socket. The tape is waterproof, but do not let it cross itself—a hot spot may burn the insulation.

Disston tools make fine gifts for the whole family!

DISSTON CARLSON steel tape rules are sturdy, easy to read, famous for high quality. The #3310 has a 10-foot reach; is ¾" wide; has patented swing tip and 10-second blade change features.

A tip for FATHERS

If your youngster has his eye (and his hands) on your tools, you can make his Christmas merrier with a grown-up gift of a Disston D-23 Hand Saw and a Disston Carlson Rule. He'll get a lifetime of satisfaction from these fine tools. And both you and your son will find you have more family fun when you join forces and "do-it-together."

A hint for SONS

Wondering what to get Dad for Christmas? How about a Disston D-23 Hand Saw and a Disston Carlson Rule? Dad will really appreciate these fine gifts—and be proud of you for being smart enough to buy Disston. Disston, you know, is the saw carpenters use. If Dad already has a 5½-pt. or 8-pt. Disston, get him a 10-, 11-, or 12-pt. for fine finishing work.

AND a word for MOM!

You can keep *all* the men in your family happy, Mom, with Disston tools for Christmas. (It's a good way to get some work done around the house, too.)

Prices vary slightly in some localities.

SEE . . . TOUCH . . . and TEST

these and other fine Disston Tools at your favorite hardware or tool store. Stop in tomorrow . . .

DISSTON-HKP

Henry DISSTON DIVISION

H. K. PORTER COMPANY, INC.

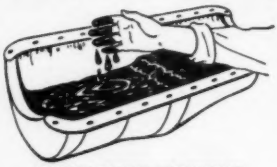
Philadephia 35, Pa.

Care and Feeding of Engines

BY S. P CORP

CRANKCASE DILUTION

Driving habits can contribute to sludge in your crankcase and sluggishness in your engine. Slow speeds and short trips keep the engine too cool to vaporize the normal condensation. Sludge results. You can help correct this by changing oil oftener, draining out the water with the drained oil. Also, you can increase engine operating temperature by using a 180° thermostat —in which case, use only permanent anti-freeze.

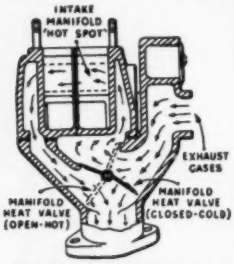


SLUDGE IN THE CRANKCASE

Sluggish operation may also be caused by a thermostat which is stuck in the open position. If your water gauge shows engine to be operating at less than 180°, have thermostat checked or replaced with a new one.

MANIFOLD HEAT CONTROL VALVE

The job of the manifold heat control valve is to heat the fuel mixture during engine warm-up, while the valve is closed. It should open thermostatically as soon as the engine is warm. If it is stuck and stays closed, the fuel stays too hot and too lean, the engine may miss, the effect of a good tune-up be ruined. Don't blame spark plugs until you check this valve, which is mounted in exhaust manifold below the carburetor. (In Ford V-8's, it is in the cross-over pipe ahead of the right manifold.) If you find this valve is stuck, free it by lubricating with a mixture of kerosene and soda, or use a good carburetor cleaning fluid.



MANIFOLD HEAT CONTROL

YOU NEED THIS FREE MANUAL

Write for your free copy of "Care & Feeding of Engines," a 24-page illustrated handbook of engine care which may save you a lot of time and money. When you re-ring, be sure to use SEALED POWER KromeX Ring Sets. Their chrome faces fight heat and friction, and they seat fast, control oil immediately, and give you double ring life. Sealed Power, Dept. H-12, Muskegon, Mich.

Sealed Power

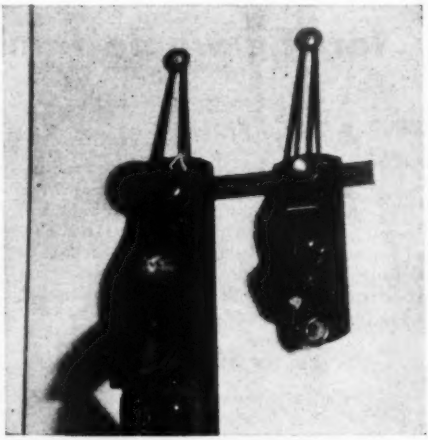
PISTON RINGS

Marking Off Rough Metal

PENCIL lines will stand out clearly on embossed aluminum and other sheet metal if you put them on broad chalk marks. Wipe the chalk off later with a rag or a stiff brush dipped in soapy water.

Tubing Protects Your Seedlings

THE cardboard tubes from paper-towel rolls are handy sleeves for protecting tomato and other seedlings from cutworms. Push a short section over each plant and into the earth when transplanting.—*R. M. Woodbury, Natick, Mass.*

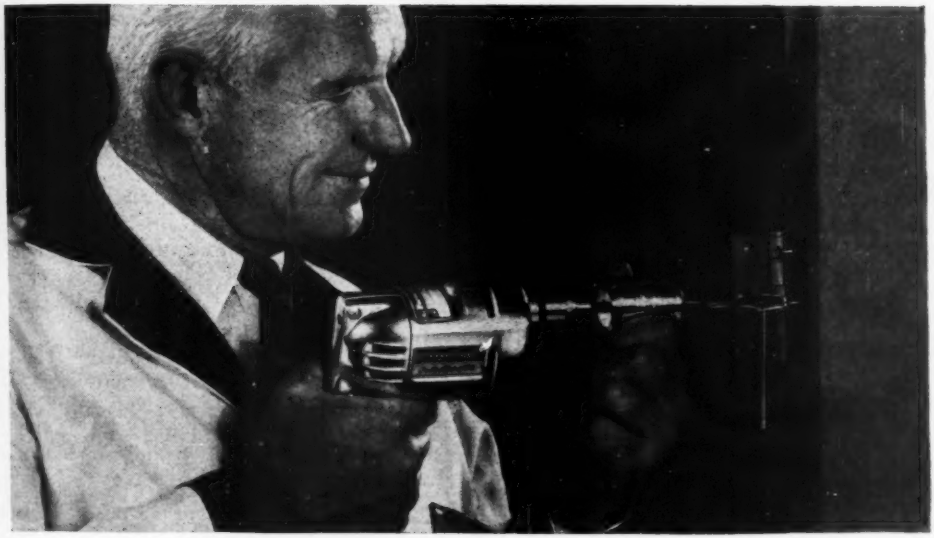


Suspenders Save Plane Blades

HANG your planes from quickly made suspenders and the cutting edges won't get banged accidentally. Fasten a loop of stiff cord to a wall with a screw and washer. A cleat nailed under the planes will keep the blades off the wall.

New versatile
Screwdriver Kit only $36.95

It's a ¼" drill...a screw setter...a power screwdriver!



Porter-Cable's amazing new Screwdriver Kit gives you *three* of the world's handiest tools—at a real bargain price, if you act now.

The matchless Porter-Cable drill has all the speed and power you will ever need for any kind of drilling up to ¼" in steel and ½" in hard wood.

The unique screw setter attachment drills precision pilot holes for the threaded portion of the screw, and a larger hole for the shank, countersinks for the screw head and counterbores for putty and wood plugs—all in one easy operation.

And simply by inserting the screwdriver attachment into the chuck, this Porter-Cable drill becomes a power screwdriver. It performs all your screwdriving needs easier, faster than ever.

This amazing screwdriver kit helps you get professional results in furniture-making, home improvements, fine cabinet work and shop work of every kind. Save $5.00 if you buy *now.*

SPECIAL INTRODUCTORY OFFER!

Model 161 Screwdriver Kit, complete with adjustable Screw Setter (for No. 8 screws) and Screw Driver attachments with slotted screw bit and Phillips bit, and Carrying Case constructed of strong, welded steel.

$41.95 value... now only $36.95

Offer expires Jan. 31, 1957

SEE YOUR DEALER—OR MAIL COUPON TODAY!

PORTER-CABLE MACHINE CO.
615B N. Salina St., Syracuse 8, N. Y.

Please send me complete information on Model 161 Screwdriver Kit and name of my nearest dealer.

Name_____

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City_____ Zone____ State_____

Porter-Cable
Quality Electric Tools

In Canada: write Porter-Cable, Ltd., Box 5019, Ont., Canadian prices slightly higher.

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Blow That Stud Down!

[*Continued from page 157*]

each series of studs—.22-caliber cartridges for ¼"-diameter studs and .32-caliber cartridges for ⅜" studs.

Various combinations of studs and powder charges are recommended for different fastening needs. Studs with smooth shanks are for concrete. Those for steel are knurled. At the start, it's best to fire a test shot or two, trying a light charge first. The bigger charges are used when you want a heavy stud to penetrate deeper, or when shooting through hard material.

Ordinarily, each stud-and-powder combination will shoot all the fasteners to the same desired depth. If there are hard or soft spots in the work, you can switch to a stronger or lighter powder load.

In the case of the concrete-block wall, it's best to experiment on a spare block first to make sure that the stud won't go through. Also try to space the studs so that they hit the webs where the blocks are solid, not the core holes.

To fasten "soft" materials like wood, fiberboard and light metal to steel or concrete, small metal disks are supplied. The disks fit into a recess in the barrel and form large washers when studs are driven through them. They also prevent cracking when a stud is driven directly into concrete and help "slow down" a stud when even the lightest charge proves too heavy.

Interchangeable barrels. Some big guns can be adapted to take several sizes of studs and powder charges. One .22-caliber model, for instance, has a screw-in-barrel that can be replaced with a .32-caliber conversion kit so that you can use the larger ⅜" studs.

This larger barrel also has a special "step-down" bushing so that you can still use .22s where they will fire the bigger ⅜" studs satisfactorily, or where you may need a lower powder charge to handle a light job.

Other guns take cartridges up to .44-caliber—and that, brother, is big-game shooting! END

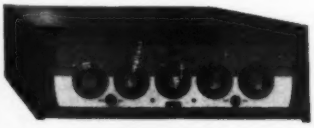
For HIM for HER for you

GENERAL ELECTRIC HI-FI MEANS ENDURING MUSICAL ENJOYMENT!

G-E GOLDEN CO-AX

12-inch Dual Coaxial Loudspeaker

Combines a 12-inch woofer, a 2¾-inch tweeter, and built-in electrical-mechanical crossover system. Handles 25 watts of power. Distortion free response—40 to 15,000 cycles... **$44.95**



G-E CONVERTIBLE

20-watt Amplifier and Pre-Amp

Dual chassis design for independent installation or use as a complete unit. This flexible, low-cost component provides 7 panel-mounted controls. **$99.95**

Loveliest of all—the gift of great music through the years. Awakened for you in new splendor by the magic wand of General Electric Hi-Fi. Here are components designed for a lifetime of superb musical enjoyment. Ideal for anyone who appreciates the finest.

The incomparable General Electric cartridge puts new brilliance in your recordings at modest cost. Ranging upward, you'll find General Electric speakers, the sensational 20-watt Amplifier and Pre-Amp, and other superb components each adding in its unsurpassed way to a quality of reproduction famous in professional circles. Fortunately, all General Electric components are sensibly priced. Examine them at your local dealer's, or write today for our free booklet of new Hi-Fi ideas. *General Electric Co., Special Products Department, Section R61126, Electronics Park, Syracuse, N.Y.*

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GENERAL ELECTRIC

SHARPENS

TOOLS, CUTLERY, SCISSORS

BY GENTLE HONING

NOT HARSH GRINDING

Here's the smooth, gentle honing action of a fine-grained oil stone—harnessed to a precision engineered electric motor geared to turn the stone at the correct speed for perfect honing, instead of harsh grinding that wears away and misshapes blade edges (see microphoto). Adjustable tool rest and angle guide assures accurate honing. Two-purpose stone has fine and extra-fine sides. Size 4" high x 6¼". Price: $19.95.

Unretouched microphotos of knife blades magnified 120 times.

ORDER BY MAIL

under full money-back warranty, or at your favorite store.

WARREN SALES COMPANY

Box 161H, Cranford, New Jersey

Manufactured by E. F. Britten & Co., Inc. • Cranford, N. J.

How to Choose the Right Tone Arm

[Continued from page 180]

one degree. But any pantograph needs extra pivots, which may get out of whack from wear or abuse. The B-J pivots are ingeniously arranged so that the counterbalance weight does not increase the lateral inertia of the tone arm. This feature improves its performance on eccentric records.

Whatever the type of tone arm, there are some other mechanical points worth a close look. Some make the arm more convenient to use, others affect performance.

Vertical pivot. When a warped record (most are slightly warped) causes a tone arm to rise, the stylus is pushed ahead in the groove; when the stylus rides down the warp it is dragged back. This motion of the stylus relative to the groove causes a wailing "wow" sound. The back-and-forth movement is least if the vertical pivot is set far back from the stylus and close to the record.

Static balance. If the tone arm is exactly balanced on its lateral pivot, it won't swing by itself if the pivot is tilted. Some tilt is almost inevitable, and static balancing prevents the tone arm from trying to push itself across the record.

The vertical stop built into a number of tone arms prevents the stylus from banging into the turntable surface. The arm can drop no lower than is necessary for contact with the record.

Resonance. The tone arm gets involved with the music itself at a particular low pitch, when the weight of the arm vibrates in sympathy with the springy pickup. All the tone arms that we checked were okay on this point, if used with flexible—highly compliant—pickups (compliance of 2.0 millionths of a centimer per dyne or better). Their resonances would occur below 20 cycles, the lowest pitch likely to be found on a record. In fact, these arms could be made considerably lighter, for use with the better pickups, without running into resonance trouble. Less weight would improve performance on warped or eccentric records. END

You Sand Like An Expert with a DREMEL Straight-Line Action Sander

Professional experts sand *with-the-grain* of the wood, to get a velvet finish. And that's the way *you* sand, when you use a Dremel Straight-Line Action Sander.

Sands in a Straight Line

The Dremel duplicates the back-and-forth motion the old-time craftsman always used when he sanded by hand — before he had a Dremel. That's the secret of getting a finish that is smooth as glass.

Other sanding motions sand across-the-grain — leaving scratches and orbital swirls. These become especially noticeable when you stain, varnish, or lacquer and spoil the finished appearance of your wood.

That's why so many experts — and novices, too—insist on a Dremel for sanding woodwork, furniture, cabinets, boats, wood paneling, and many, many other projects.

You Can Polish, Also

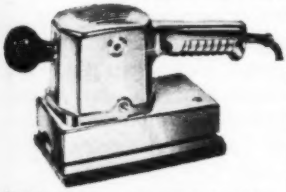
You're not limited to sanding, with a Dremel. You can remove the sandpaper and slip on a polishing pad.

Then you're all set for speedy, effortless polishing of furniture, your automobile, or any other waxed surface.

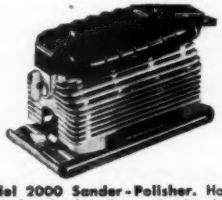
Dremel Straight-Line Action Sanders are available in three sizes. See your local power-tool dealer and ask for a demonstration. Compare with other makes for price, performance, simplicity of construction, and ease of handling. A close-up comparison will convince you that a Dremel is your best all-around buy.

See the Dremel at your hardware store.

Give a Dremel Sander this Christmas.



Model 53. Heavy-duty unit designed for rough, medium, or fine sanding. Powerful ROTARY MOTOR will not stall or burn out. 24 sq. in. sanding pad. Wgt. 5¼ lbs. Easy handling. $34.85.



Model 2000 Sander-Polisher. Handyman's favorite for all household or hobby projects. Easy to use. Wgt. 5 lbs. 21 sq. in. sanding pad. Includes steel carrying case, 1 polishing pad, 25 assorted abrasives. $24.50. **Model 2000 Sander only** (less case) — $19.95.

Model B. A sander, polisher, and massager all in one. Light with smooth, powerful action. Wgt. 2½ lbs. 13 sq. in. sanding pad. Includes 6 abrasives, polish pad, massage pad. $14.85.

D-2

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Mammoth 1957 Wholesale Tool Catalog

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Inside the 1957 TV Sets
[*Continued from page 79*]

special tubes that were developed for it.

Smart shoppers used to ask how many tubes a TV set had. Nothing will fool you faster today, for the vacuum-tube people now combine two or three separate tubes into one. Crystal diodes also replace some tubes. So the chart indicates *tube functions*—the number of tube jobs performed in the set. The more tube functions, the better the set *ought* to work.

What kind of picture. The brightness you get depends greatly on the high voltage on the picture tube, with the small-screen portables needing much less than the standard 21-inchers. An aluminum coating on the face, now practically standard, helps here, too.

Nearly everything in the works affects the fine detail your receiver can display, but two clues to quality are the number

NEXT MONTH . . .

Art Margolis solves the mystery of the electrocuted TV sets—and gets into some narrow scrapes himself.

of intermediate-frequency stages, which amplify the picture information, and the intermediate-frequency bandwidth, which establishes limits to picture detail.

Most portables have only two IF stages, most standard sets have three, and a few quality receivers have four. IF bandwidth need not be greater than four megacycles—that's as much picture detail as the transmitter puts on the air.

Interference. A whole raft of circuits is engineered into a TV to keep out electromagnetic waves that did not come from the transmitter. You should look for:

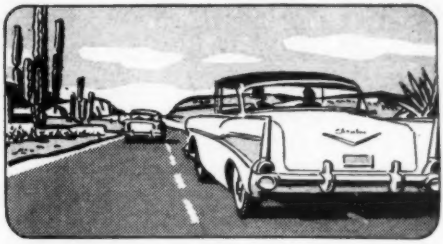
- FM traps, which stop signals from FM radio stations;
- High-pass filters, which keep out short-wave radio signals;
- IF traps, which protect the sensitive intermediate-frequency amplifier;
- Adjacent-channel traps, which guard a weak signal on one channel from a strong one on the next channel. (These

[*Continued on page 224*]

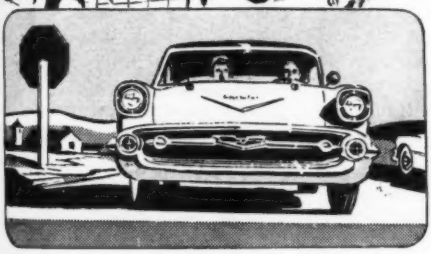
"You have more to say about gas mileage than you think!"

Mauri Rose

One of America's top professional drivers for over 25 years, three-time Indianapolis 500-mile winner.



"Speed plays an important part in your car's gas consumption. Stock cars are built for peak efficiency at cruising speed, not top speed. Speeders not only take unnecessary chances, but also waste gas."



"A pro knows it doesn't pay to race away from stops. Accelerating hard in low gears eats holes in gas mileage. And it's not worth the wear on your engine . . . you get there just as soon taking it easy."

"And to be sure you have the final say on gas mileage, have your carburetor and other vital engine parts checked regularly by a factory-trained mechanic. Don't wait until your car starts to act up!"

When tune-up time rolls around for your car, be sure to see a Rochester Carburetor specialist. He is thoroughly trained in all phases of carburetion by GM and UMS experts. He'll give your car the kind of care that only a factory-trained mechanic can. When it comes to long life and dependable service, he knows that Rochester Carburetors are second to none. They're precision-built for top performance on high-compression engines. And Rochester Carburetors deliver *just* the right mixture, at *just* the right time, to squeeze extra mileage out of every gallon of gas.

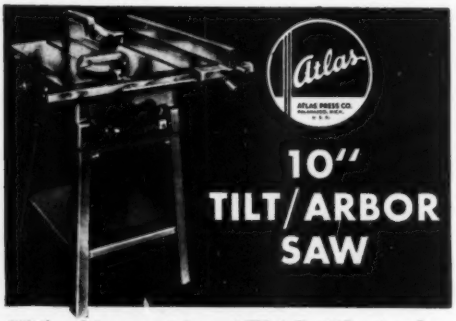
Standard equipment on Cadillac, Buick, Oldsmobile, Pontiac and Chevrolet.

ROCHESTER CARBURETORS

GM PARTS SALES

ROCHESTER PRODUCTS DIVISION OF GENERAL MOTORS CORPORATION, ROCHESTER, N. Y.

With this superb jointer-planer you can plane, end-joint, tongue, bevel, or rabbet wood of any size with unequalled accuracy, ease and safety. Satin-smooth, ripple-free finish. Larger table and fence, heavier solid-steel cutter-head spindle. This is the jointer-planer you need to give your work that professional quality. Ask any experienced woodworker. Write for descriptive literature.



With this precision ATLAS 10" circular saw you can do almost every basic woodworking operation . . . faster, more accurately, and with greater safety. You can crosscut, rip, miter, dado, and shape with greater ease, precision, and smoothness. Unexcelled for general carpentry, this great saw also gives you versatility you need for fine cabinet work, built-ins, trim, and furniture projects. It's the only saw with rigid triangular arbor support, balanced tilt mechanism, bigger arbor, push-pull depth and angle control, and double-locking lift-off fence with vernier control.

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Atlas Press Company

12-25 N. PITCHER ST., KALAMAZOO, MICHIGAN

Inside the 1957 TV Sets

[*Continued from page 222*]

are not needed if all the stations you watch are about equal in strength.)

• Noise killers, which stop interference that might upset the synchronizing circuits.

One *source* of interference is being eliminated this year by government edict. This is the bar pattern that one receiver puts on the screen of another one nearby. You should find pasted to the back of a new TV a label guaranteeing that the set meets Federal requirements limiting the amount of radiation it generates. This improvement protects your neighbors but doesn't help you until your neighbors also buy new sets.

Stability. To keep picture quality constant despite variations in the signal, all sets have automatic gain control ranging from simple derived types to fast, accurate keyed types. Keyed AGC is more effective at preventing the fluttering picture caused by a passing airplane.

Since a very strong signal may overload the AGC, it may be adjustable. A continuously variable control naturally provides more accurate adjustment than a simple two-position switch.

Transformers. Whether a set has its tube filaments wired in parallel and powered through a transformer, or wired in series without a transformer, matters little except in servicing. In transformerless sets, burned-out tubes are harder to find and the chassis is electrically hot.

This year a few more manufacturers eliminated transformers, but one of the biggest—RCA—reversed the trend. All '57 RCA receivers, even portables, have transformer-fed power supplies.

Now about that color. The Very Important Shows this year will be telecast in color, and there'll be some color to watch 'most any night. (You can see them in black-and-white anyway, of course.) A good 21-inch color receiver can be had for less than $500. About 60,000 people made the plunge in the first six months of '56, and the figures are still continuing to climb. Want to shake the piggy bank again? END

IDEAS FROM WELDWOOD

The Sail Scooter. Sporty sailer you can build at lowest possible cost. Sail Scooter is portable, can be carried on top of your car.

Sportman's Cabinet. 2-sided cabinet on swivel base. One side holds clothes, shoes, etc. Opposite side for tackle, rifles, shells.

Kitchen Cabinets. Pattern has all information to build cabinets, broom closet and sink enclosure. 200 sizes of cabinets specified. Step-by-step directions.

TV and Hi-Fi Enclosure. Cabinet (right) has turntable, space for tuner, amplifier. Cabinet (left) holds speaker. Center holds TV set.

Projects of the Month

This month we're suggesting four money-saving projects. They're all *simple* to make with Easi-Bild patterns, and Weldwood plywood.

Easi-Bild* patterns are *full size*. You just trace the pattern, cut out the pieces, and assemble. If you know a saw from a hammer, you can build any of the 250 Easi-Bild projects. (See coupon for details.)

When you send for the patterns, or buy them at a store, you'll see the name "Weldwood" on the list of materials. In top grade plywood . . . in beautiful hardwoods . . . in finishing materials like Firzite® and Satinlac® . . . and in glues and Contact Cement, Weldwood products are favorites of amateur and pro. For any project—any need—rely on Weldwood products, and the dealer who sells them.

*T. M. Reg. Easi-Bild Pattern Co.

This month's hint

If you don't have a vise—or four hands—nailing together picture frames or anything else with mitered corners is a problem.

To make the job easier apply Weldwood Contact Cement to all joints and let it dry (follow directions on container). Then, simply press the pieces together. The frame will bond instantly and solidly and you'll have no trouble putting in necessary nails.
—C. D. H., Lumberton, North Carolina.

The Weldwood Question Box

Q. I'm doing cabinetwork at home. What kind of plywood is best?

A. You can use fir, pine or hardwood plywoods (like mahogany, oak, etc.). The hardwoods are the best looking. But, if you're going to paint, take a tip from cabinetmakers and choose Weldwood Old Craftsman Pine Plywood. It's easy to work and paint. There's no discoloration and much less grain "showthrough." Weldwood Old Craftsman Pine doesn't need as much sanding, paint or painting time.

The choice of materials is up to you. But remember—the "pros" pick pine!

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Please send me the following checked items:

( ) Pattern #272—TV and Hi-Fi Enclosure ($1.00)
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( ) Pattern #248—The Sail Scooter ($1.50)
( ) Pattern #266—Sportsman's Cabinet ($1.00)
( ) 57-page Pattern Catalog (35¢) PS12-56

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Save expensive repair bills

Built in our own factory these big industrial capacity, portable welders provide terrific performance, yet are sold direct-to-you at bedrock factory prices—hundreds of dollars less than you'd expect! Senior model (shown above) has high capacity DC welding unit—easily welds any thing up to 2" plate using 1/16" to 1/4" rods. Built-in stabilizer and cooling system makes arc easy to strike and hold. Dual control rheostat provides low heat soldering, brazing, and welding from 30 to 300 amps. Comes complete with instructions, guarantee and triple V-belt or flat pulley. Easy to hook up and easy to operate.

WELDER ONLY—DUAL CONTROL MODEL. Same as above, but drive with your tractor, jeep or gas engine of 14 HP or more. (Item 38a) Wt. 110 lbs. $450 value..... **$119.50**

WELDER ONLY — INDUSTRIAL MODEL. Same as above but with ceramic rotary type control providing 74 different heat settings for all types of welding (Item 38b) $500 value **$139.50**

COMPLETE POWER MASTER (Illustrated at right) Powered by a heavy duty 14.6 HP air cooled Wisconsin engine—belt driven. Wt. 480 lbs. (Item 280) Welder has ceramic rotary control with 74 heat settings. Compares with welder costing $1200. Factory Special..... **$449.50**

WELDING KIT. Two 10 ft. leads, welding helmet, electrode holder, ground clamp. Sold only with welder at... **$10.50**

52 pc. SOCKET SET. Highest quality, guaranteed non-breakable sockets made by Husky. Beautifully matched chrome thin wall alloy absolutely the best. Contains a complete set of 28 sockets in 1/2" drive, 3/8" drive and 1/4" drive, plus all necessary extensions, handles, speeders, reversible ratchets, etc.; all uncond. guaranteed against breakage. A beautiful set of tools that will handle any job; in a big doghouse steel box. Wt. 17 lbs. (Item 205) List Price $62.90 Factory Special **$27.95**

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(Item 10) Easily installed in furnace pipes. Forces even heat to all rooms. Over range removes kitchen smoke and odors. Powerful, continuous duty motor, 110-120 v. AC. Mount in wall or ceiling to ventilate any area. Quiet, super-efficient fan moves huge volume of air. (400 to 600 CFM).

8" Pipe, wt. 5 lb. $6.85
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12" Fan, wt. 10 lbs. (Item 10D) $12.95

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Straight, curved, single or double
With any color paint, stripe furniture, bikes, autos, model planes, toys, linoleum, wallboard. Clean, crisp decorative lines. Can't clog or smear. Also use with glue, tempera, textile paint or undergiaze . . . on wood, glass plastic, ceramics, metals, fabrics and paper.
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Complete Kit (all 7 tips) $5.00

Extra tips 90c ea.

Extra 1/4' tip...$1.20

WENDELL MFG. CO. 4234 LINCOLN AVE., Dept. 224 CHICAGO 18, ILLINOIS

Fastest Sub Points to Future

[*Continued from page 85*]

beneath the sea, they could, Admiral Mumma says "roam the oceans of the world at will to launch deadly weapons against targets far inland."

Far more potent, those 1957 subs will be much less vulnerable than battleships. Besides their speed and maneuverability, they will be able to dive below any depth at which they are likely to be reached by bombs or depth charges, too deep even for most sound apparatus to locate them accurately.

The men who designed the Albacore knew that two forces impede a submarine:

- Skin friction. To overcome this, the sub's outside was made as smooth and as small in area as possible.
- Eddy-making resistance. To overcome this, all appendages (fins, for instance) were streamlined or were dispensed with. There is no flat deck atop the ship. Her circular hull section also offers the greatest resistance to the high pressures at great depths.

The Albacore glides through the water like a porpoise. Once, when her propelling screw had been removed, she was being towed beneath the surface by a vessel upon it. The surface ship stopped; the Albacore slid right on past.

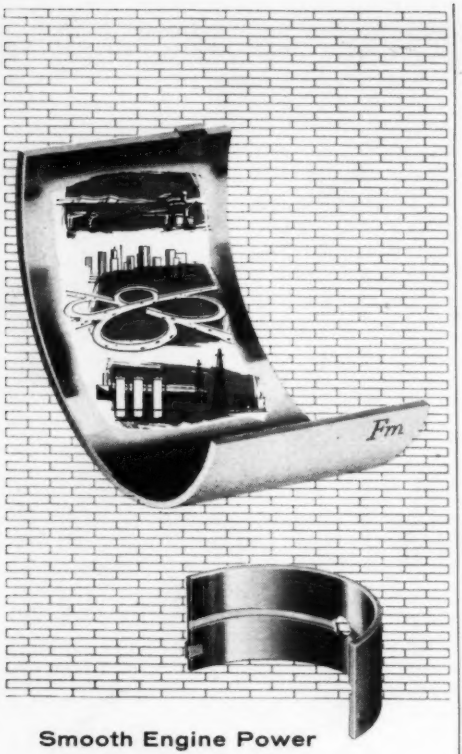
"Look at this stubby, round hull," Skipper Boyes says, as he shows you a model of his ship. "That, I believe, is the fashion of the future. The style is going to be short and plump."

He thinks that not only will future submarines and battleships look like the Albacore, but passenger ships, freighters and tankers will, too. He thinks the day will come when almost all vessels will travel beneath the sea—not upon it.

The reason is simple. It is almost impossible to improve the performance of surface vessels any further. A surface ship is held back, like a submarine, by skin friction and eddy-making resistance, but in addition by pitching (a broncobucking swing of bow and stern), heaving (the rise and fall of the entire hull),

[*Continued on page 228*]

FREE FOLDERS at your dealer's, or write: MILLERS FALLS COMPANY, Dept. PS-17, Greenfield, Mass.



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Fastest Sub Points to Future
[*Continued from page 226*]

wave-making resistance (a surface ship's own bow waves hold her back), and the opposition of surface winds, heavy seas and storms.

All this makes the sea surface too much of a hydrodynamic mess. (On top of the water, even the Albacore's performance is so-so.) Possibilities are far brighter for speeding up ships that travel about 200 feet down. What has been done with the Albacore is only the beginning.

Ships patterned after her may make 80-knot, 35-hour voyages from New York to London.

Undersea travel would end disrupted schedules. Today even the Queen Mary and the United States sometimes have to turn back from storms. "In the day of undersea liners," says Boyes, "you'll set depth and course and let the automatic pilot take you across the ocean."

If that day comes, you'll fly through the sea with the greatest of ease. I felt less motion in the Albacore than in any boat, ship, plane, train or car I ever traveled.

Only climbs, turns or descents might make it necessary for you to hang on or to watch your step. But a passenger sub presumably would not do acrobatics any more than a commercial airliner does.

"It seems to me," says Skipper Boyes, "that men are going to move out into space and down into the ocean. I think the ocean will be first—and on a larger scale."

Sub-sea liners would mark the greatest change in ships since the switch from sail to steam. Underwater tugs could haul freight barges at 15 to 20 knots. Submarine salvage vessels could snatch valuable cargo from depths inaccessible now. Underwater rigs might tap oil fields under the ocean floors.

Admittedly all this is a long way off. Meanwhile, there is at hand one solid and comforting fact: By far the world's fastest and most capable submarine does not belong to any probable enemy. She is one of ours. END

A Christmas Gift

you'll both enjoy

...*together!*

Here's a gift kit built around the Stanley Router that makes working together easy and fun. It includes the big ½ hp router that does 90% of all woodworking jobs, 5 most useful bits, a straight and circular guide, an instruction manual and 4 *free* Easi-Bild patterns of things to make. Ask at your hardware store for Stanley Router Gift Kit —

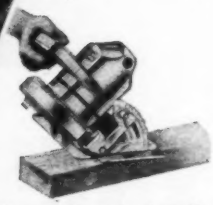
only

$67.95

complete

Another fine gift for the man of the house is this new Stanley 6½" heavy duty builders saw. It is powered by a completely ball bearing, Stanley-made motor. The exclusive "Motor-Saver" Drive protects this power against the shock of sudden impact should blade strike a nail or other foreign object. H68 makes all cuts necessary to build a standard home.

only **$64.95**



Cutting a 2 x 4 at 45°

Specify Stanley at your hardware store. Your dealer has these fine tools or can get them for you. For free catalog No. 400, write Stanley Electric Tools, Division of The Stanley Works, 63D Myrtle Street, New Britain, Connecticut.

STANLEY

Locomotive That Shifts Like a Car
[*Continued from page 76*]

goes into its rock-and-roll. Fireman McCourt shows you how to stand on the pitching deck—legs astraddle and knees slightly bent. It works.

A sudden loud explosion comes from under the engine, like a gunshot. "Torpedo!" the fireman says. It's a warning left by the train ahead to proceed with caution. But signals ahead cancel it.

As the air horn blares for grade crossings, your auto-conditioned viewpoint changes. Many crossings are blind and without flashers; only the horn warns motorists off the track. You resolve to have car windows open and the radio low at unprotected crossings hereafter.

Even where the train is in plain view, some drivers put on a spurt to beat it across. This trip, they all make it. One dashing soul pulls up almost on the track, then backs away. McCourt grins.

"People are funny," he says. "Even when they're walking, they'll run across in front of the engine, and then stand on the other side to watch it go by."

Riding the cushions part of the way back, you find the reclining-seat coaches much smoother than the engine.

Each car has a single axle at one end only, and rides piggyback upon the next. With this setup, you'd expect cars to kneel down like tired camels when uncoupled. Instead, two dolly wheels come down to hold the axle-less end up.

Connecting two air lines, 42 circuits and a three-phase 440-volt power line between each two cars sounds like a yardman's nightmare. But it all happens automatically—and for good measure, the air draws up those dolly wheels.

Getting off at Cleveland, you ask Fred Kurtz, Baldwin engineer on the return run, how much fuel oil is used.

"We haul nine cars and 392 passengers," he says. "For the 520-mile round trip, we take on 500 gallons." His eyes twinkle. "How much gas would your car burn to carry the same load?" END

$5.00 FOR YOUR OLD HAND SAW OR POWER SAW!

ANY MAKE OR CONDITION!

Your old hand or power saw (any make or condition) is good for a $5 trade-in allowance towards purchase of the amazing new Syncro "210" True-Cut Jig Saw at your tool dealer! This husky, massive, precision-built saw has big 15" throat, 100 sq. in. table—cuts 1¾" wood accurately—curved or straight! Powered with famous Syncro Reciprocating Motor—greatest achievement of power research. No belts, cams, gears. No rotating parts to wear out. Motor guaranteed against burn-out during ownership.

See your tool dealer today—trade in your old hand saw and save $5! Offer ends Dec. 31, 1956.

MODEL 210 LISTS: $29.95
Less $5 Trade-in or . . . $24.95

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210 JIG SAW

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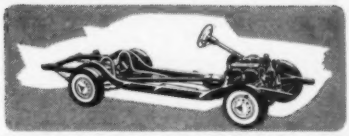
WORLD'S LARGEST MANUFACTURER OF RECIPROCATING MOTORS



X-RAY ON CHEVROLET

This is the '57 that gets whistles from engineers!

Fuel injection on expensive foreign cars is an achievement—but in Chevrolet's class it's close to an industrial miracle! That's one of the big things that have engineers excited about the '57 Chevrolet. But look at some other precedent-breakers:

Five advanced engines, from the "Blue-Flame 140" Six through four V8's—and, with Ramjet fuel injection,* the top engine in the line produces an astounding 283 h.p. from 283 cubic inches! . . . one horsepower for each cubic inch! That's terrific efficiency!

Two automatic drives. One of the world's best-tested automatics, Powerglide.* And a brand-new torque converter, Turboglide,* with Triple-Turbine take-off. There's even a new position on the quadrant—Hill Retarder—that adds the braking power of the converter to that of the engine on hills.

Smaller 14-inch wheels. And Chevrolet uses softer tires with only 22-pound air pressure for a better ride. And there's better traction, too, that enhances Chevy's superior weight distribution.

Integrated bumper-grille styling. Smooth and clean, with no separate bumper hung on as an afterthought, it delights the eye. And there's no clutter of small pieces and fastenings to get loose and rattle. Chevy's tail assembly also follows the same modern trend for that tailored-in-steel appearance.

**Optional at extra cost.*

CHEVROLET

From the '57 Chevrolet's bold prow to the tip of its flight-flared rear fenders everything bears the stamp of advanced engineering . . . engineering that must be seen and sampled by anyone interested in tomorrow's automotive design. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

no other plier
does so many jobs
SO WELL

CHANNEL LOCK
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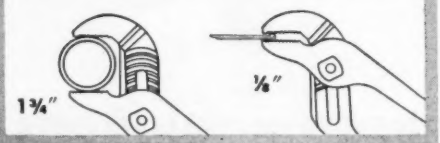
GRIPS LIKE A PIPE WRENCH



Help yourself to a Channellock No. 420 . . . the handiest plier of them all. With this handy plier, you can grip anything from a cotter pin to a 1¾" hex nut. And what gripping power! Just like a pipe wrench. What's more, Channellock is streamlined . . . easy to use in hard-to-get-at places. This all 'round usefulness is the reason why Channellock is the favorite plier of craftsmen everywhere. It'll be your favorite, too . . . for the same reason. Ask your hardware man for a Channellock No. 420.

BE SURE IT'S A GENUINE CHANNELLOCK

CHAMPION DEARMENT TOOL Co. MEADVILLE, PA.

[*Continued from page 89*]

the equivalent of two or three cocktails or highballs we react a trifle more slowly to the sudden flash of a light or the ring of a bell, and that we do not type, sew, add, memorize, sort out cards or do other such tasks quite as well.

SINCE our center of judgment is depressed, however, we are likely to *think* we can do everything better. When it comes to driving after a few drinks, the chief danger may well lie not in the fact that our reaction time rises—as it does—but that our confidence zooms. For the overconfident driver takes chances.

Incidentally, the Uniform Vehicle Code says that if the concentration of alcohol in your blood is under .05 percent, you are assumed to be sober. This is the level a 150-pound man generally reaches with two cocktails or three cans of beer before dinner, or twice as much after. Actual intoxication—drunkenness—starts with a level three times as high.

Hangover?

Dr. Greenberg once tried to induce this painful state in some of his graduate students by giving them a pint of whiskey apiece. No luck. It knocked them out, but in the morning, aside from queasy stomachs, they felt all right.

"They did not have what the average person means by a hangover, because they had not gone through the whole fatiguing process of a party—too much eating, too much smoking, too much horsing around and then too little sleep. They had simply had their drinks and fallen into bed."

There was another reason. Hangovers can be at least partly psychological; if you feel guilty about your drinking, it hits you worse. These men had downed their alcohol as a research project and their consciences were clear.

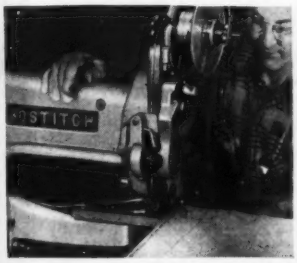
BESIDES deadening us to the effects of fatigue, too much alcohol upsets our electrolyte, or mineral, balance. Some of the water inside our tissue cells flows

[*Continued on page 234*]

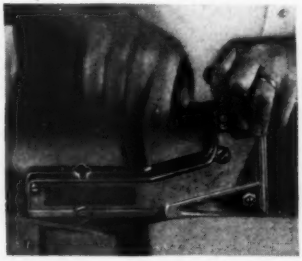
Whatever your business...

you save money with stapling

Below you see five of the vast number of businesses which report savings with Bostitch stapling. In shipping, Bostitch provides quick, easy carton closures—on seams, tops and bottoms—that actually strengthen the cartons. In production, everything from paper to sheet metal is fastened with Bostitch equipment—speeding output, cutting costs. A Bostitch Economy Man will be glad to help with your fastening problems. He's one of 375 trained fastening specialists working out of 123 cities in the U. S. and Canada. Over 800 different models of Bostitch staplers use 200 types of staples, tailored to the job.



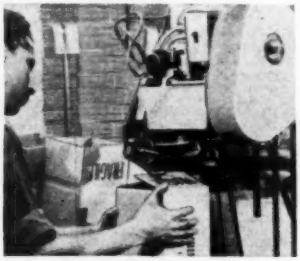
These steel freezer cabinets, once spot-welded, are now wire stitched. *"Bostitch method trims fastening costs by 75%."*



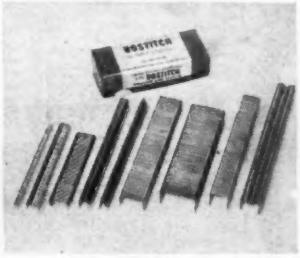
Using Bostitch Autoclench stapler, this man says he seals boxes *"five times faster"* than he can with glue. Saving *"over 50%."*

Air freight bills stapled to corrugated containers with new-type tacker *"hold better than with tape at 1/10th the cost."*

Roofers use heavy-duty Bostitch stapling hammers to lay asphalt shingles on new roofs. *"Four times faster than nailing."*



"Twice as many boxes can be stapled in an hour, with only two-thirds as much manpower." Staplers take up less floor space.



For greatest savings, use only genuine Bostitch staples in Bostitch machines. They're precision-made to work together!

FIND HOW TO CUT COSTS in your business; attach this coupon to your business letterhead and mail today.

Fasten it better and faster with

BOSTITCH
STAPLERS AND STAPLES

Bostitch, Inc., 572 Mechanic Street, Westerly, R. I.

Name _____ *Position* _____

Company _____

Address _____

City _____ *Zone* _____ *State* _____

Mobile workshop preferred by professionals

Gift idea by YATES-AMERICAN

1 Quickest change-over from saw to jointer to sander.

2 Compactness with capacity.

3 Quality features—patented feather-touch rip fence.

Take a cue from the craftsmen. See your Yates-American dealer today, or write for colorful catalog.

Yates-American
BELOIT, WISCONSIN
Department P, 783 N. Fourth Street

What Happens When You Drink
[*Continued from page 232*]

through the walls, taking potassium, sodium and other minerals with it, and joins the water outside the cells. That's why hungover people have a thirst, but drinking quantities of water before going to bed won't help, because the stuff won't stay in the cells, where it's needed.

Contrary to general belief, little water or mineral matter is lost in the course of heavy drinking but the balance remains upset until the alcohol is burned up. Neither exercise nor any other measure known will hurry this burning process.

Does drinking warm you up?

You only think so. Blood vessels temporarily dilate and carry more blood. Those near the skin give off heat to the outside. You feel it as an increase in heat; actually you are losing heat. In heavy drinking, this heat loss can be dangerous.

What about the permanent effects of drinking?

"In the moderate drinker," states Dr. Greenberg, "we haven't found any." He defines a moderate drinker as a person who seldom takes more than a few drinks a day, and whose drinking does not get him into trouble.

ALCOHOLICS—people who can't stop after a few drinks—are another matter. Their excessive consumption of alcohol cuts down their normal intake of protein, vitamins and minerals, so they often suffer severely from nutritional deficiencies. Most of them have a disturbed liver, too; about one in 12 gets cirrhosis of the liver, and one in 10 delirium tremens or some alcoholic mental disease.

"Present scientific knowledge," Dr. Greenberg reports, "provides no physiological explanation of why some people—four million out of 65 million drinkers in the United States—become alcoholics. We have to handle it as a personality problem."

What about the argument that without alcohol there would be no problem?

"The evidence down through the ages is all against that," he answers. "The problem isn't alcohol; it's people." END

AMAZING NEW IMPORT

TERRESTRIAL & ASTRONOMIC TELESCOPE

79.95 WITH TRIPOD

83 POWER—40 POWER or 23 POWER PLUS A VARIABLE 25 and 60 POWER TERRESTRIAL TELESCOPE

Look what you get at this Low Price PLUS a Money Back Guarantee & a 10 Day FREE Trial! You can't lose unless you miss this!

1 – Astronomical LENSES – Three of 23X, 40X and 83X magnification. Achromatic & precision ground.
2 – Variable Power LENS of 25 & 60X for straight through viewing. Fully corrected for Terrestrial sightings.
3 – BODY – Steel for a lifetime of use.
4 – LENGTH – 19-1/2" 22-1/2" extended.
5 – Objective LENS – Coated large 50mm.
6 – Top Quality SUN FILTER
7 – One Diagonal PRISM
8 – 4 Power x 10mm Searching Scope with cross hair reticle.
9 – ADJUSTMENTS – Both free-swinging and universal with lock for positioning.
10 – Hardwood TRIPOD – Two section type. 30" folded. 4-1/2 ft. extended.
11 – Fitted Hardwood CASE for all parts.

FREE BOOK ON STARS – Tells you all about the stars and the constellations – Where to find them at different times – How to identify them and many other intriguing facts on astronomy.

EXTRA 100X EYEPIECE 7.50 125X EYEPIECE 9.95

83 and 40 POWER ASTRONOMICAL SCOPE

Only 49.95

Very similar to scope above but has 83X & 40X eyepieces with a 40MM objective lens. Also has a variable eyepiece of 25–30X. Steel tube body is 26" long. Included with scope is sunglass, a pair of prisms (1 erecting), a hardwood tripod and a fitted case.

25 POWER x 30 MM TELESCOPE & TRIPOD

NEW 8.95 25.00 VAL.

Nowhere but at PALLEY'S can you find a buy like this! Here's a scope, complete with a sturdy metal tripod, that you can have a lot of fun with. Use it to spot hits on the target, for star-gazing, interesting views at the beach, etc. Made of aluminum and chrome plated brass. Field: 62 ft. at 1000 yds. 1-3/16" dia. lens.

AMAZING NEW DESIGN
60 to 600 POWER – 2 EYEPIECE

SPECIAL MICROSCOPE

HAS 60 - 120 - 200 - 300 - 400 & 600 POWER MAGNIFICATION WITH ILLUMINATED SUB-STAGE MIRROR and TRIPLE TURRET

NEWLY DEVELOPED IMPORT

Now you can change magnification with a simple shift of the dual eyepiece turret. No loss of focus – No re-adjustments – Your choice of 6X or 20X eyepiece with any of the objective lenses instantly!

INCLUDES THESE ADDED FEATURES:

Has triple revolving turret with 10X, 20X, & 30X precision ground and polished lenses – Dual eyepiece turret with 6X and 20X lenses – New Patented Sub-Stage with a built-in, battery operated light, no external light source needed – A large sub-stage mirror with revolving variable iris – All-metal precision made body, inclines through 90° – Special fitted hardwood case and glass slides. Ideal Xmas Gift!

SPECIAL $16.95

SAVE UP TO 50% ON XMAS BARGAINS

AMAZING CRYSTAL RADIO

NEW

Here is A COMPLETE SELF POWERED RADIO RECEIVER that picks up STANDARD BROADCAST STATIONS without using batteries or electricity! Just plug in the headset, antenna and ground wires and tune in your favorite program. You'll be amazed at the STRONG, CLEAR SIGNAL. Nothing to assemble – nothing to buy. Has a 100KC tuning range. Comes complete with the receiver, sufficient antenna and ground wires PLUS A HEADSET with two 2000 ohm earphones. Ideal for that personal or private radio.

ONLY 3.95

Special 12 Pc. SPORTSMAN'S KNIFE

3.95 CASH 12.95 VALUE

Complete with Genuine Leather Holster!

NEW LOW PRICE – Same high quality. Over 20,000 sold last year – because of this large volume we are able to greatly reduce our price to you – SAVE!

IDEAL GIFT FOR FATHER, SON or FRIEND

ELIMINATE 12 ITEMS FROM YOUR PACK

Here is the Perfect, Combination Knife-Tool for every Outdoor Sportsman, Hunter, Camper, Fisherman, Boy Scout, Ranger, Rancher, etc. Think of it! 11, Fine quality Steel Tools, precision made to fold easily into the heavy bone covered body. In one neat, compact unit you have: (1) a regular knife, (2) a fork, (3) a spoon, (4) a draw-knife, (5) a bone-saw and fish-scaler, (6) scissors, (7) a can and bottle opener, (8) a cork-screw, (9) awl punch, (10) a screwdriver and (11) a metal file. All this PLUS a genuine leather, belt holster.

NEW 11" BLADE

SPECIAL PARATROOP FOLDING MACHETE AND LEATHER HOLSTER

The latest design with a new blade shape and tapered beveled edge that is honed to cut quicker and deeper. Blade is finest, blued, nickel alloy steel. The handle is heavy bakelite with diamond point knurl to assure positive, nonslip grip. Blade folds into handle and special steel guard like a giant pocket-knife giving absolute protection to the user. When open a positive safety lock holds the blade rigidly in place. A rawhide wrist thong in handle prevents losing knife. Ideal for chopping cutting, etc. Overall 17", blade 11".

2.89 WITHOUT HOLSTER 15.00 VALUE

GENUINE HEAVY DUTY LEATHER HOLSTER – For machete above. Has belt loop and long rawhide thong for leg strap. Beautifully double-stitched throughout. One-piece, extra heavy duty leather. Comes with whetstone. $1.50

FIGHTING KNIFE

NAVY KNIFE 2.98 LEATHER HOLSTER 1.99

Dagger design with laminated leather handle. Blade is 6-1/2" long, hollow-ground on the cutting edge and double-edged for 3-1/2" at the point. Ideal skinning or hunting knife. Comes with a genuine leather belt holster. Overall length 11". Order while we can supply.

ARMY SURPLUS

NEW MACHETE ONLY 1.98

Has 22" Vanadium Steel blade with a 5" carved hardwood handle. Brand new stock. Comes with rugged belt sheath. Ideal for chopping, cutting, clearing, etc.

PORTABLE, FOLDING ARMY SHOVEL – With a 20 inch hardwood handle. Blade will fold to form a pick. Ideal for gardening or use in an emergency. 1.98

3400 RPM-½ HP POWER SAW

RIPS - CROSSCUTS

CUTS A FINISHED 2x4 LIKE A KNIFE THROUGH BUTTER

COMPARES TO SAWS SELLING UP TO $47.50 — 19.98 Complete with 5-1/2" Blade

A rugged, professional type, adjustable saw. Will cut any angle from 0 to 45°. Has an adjustable (0 to 6") rip fence. Safety-trigger switch on handle. Full ½ HP Universal AC-DC, 110-120 Volt, 60 cycle motor. Weighs only 6½ lbs. Thousands already sold. Your satisfaction guaranteed.

EXTRA SAW BLADES – Available in Rip, Crosscut or Combination. Please Specify 2.25 EA.

SAVE 50%

PHILIPPINE MAHOGANY LUAN PLYWOOD AT LESS THAN WHOLESALE

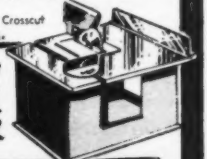
For Paneling Dens, Offices, etc. Use in Cabinets, Furniture, etc. Rotary cut. Both sides sanded. Bonded with finest resin adhesive. Face side unjointed. Shipped at lowest rates.

3MM (1/8") x 3FT. x 6 FT. $5.00 VALUE — 1.79 PER SHEET — MINIMUM ORDER 6 SHEETS

FREE SAMPLE ON REQUEST

1/4" x 4 FT. x 8 FT. 9.50 VAL. — 4.49 PER SHEET — MIN. ORDER 4 SHEETS

NEW POWER SAW BENCH TABLE



This sturdy, precision made bench-saw table converts our famous power saw (above) to a handy bench saw. Permits angle and bevel cuts, rip, crosscut & comes with rip fence and miter guide. 14" x 16" table, 6" high.

NEW ONLY 9.95

SAVE 50% ON TRANSLUCENT FIBERGLAS PANELS

Use it for patio covers, interior decor, walls, partitions and many other uses. Ideal for the home, office, shop, indoor or outdoor installations. Finest quality. Available in many widths and lengths. Excellent color selection. Write for a FREE Sample and Booklet.

49¢ SQ. FT. 85¢ SQ. FT. VALUE

FREE HOBBY CATALOG

Send for it today! Its a "Preview" of some of the outstanding bargains to be shown in our NEW 1957 CATALOG now being prepared. Listed are Outdoor & Camp equip., Models & Supplies, Microscopes and many more.

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Order From This Ad. Pay by M.O. or check. P.O.'s accepted. Send funds if deposit with C.O.D.'s. All Prices FOB Los Angeles.

This Car Can Crash Without Hurting You

[Continued from page 97]

percent of all injury-producing wrecks.

Device: The Safety Car's two doors are built to stay shut—through virtually any wreck. Latches—three steel bars in each one—slide into grooves in the top, bottom and side of the car. The locked-in steel bars also help to strengthen the car body.

You never saw doors like these on a car before, though you have seen them on telephone booths. Each door—there's one large one on each side—has two sections, hinged at the center. The front edge rolls in tracks along the full length of the opening so that the door folds outward to open.

The only trouble with some of these fine new homes they're building is their location—on the outskirts of your income.

—THE SIDEWALK SUPERINTENDENT

Fact: A bumper, Cornell says, should deflect a blow or absorb its energy.

Device: Front and rear bumpers curve around the car to help blows glance off. Bumpers along each side further protect the passengers.

The bumpers are mounted on springs. And the springs are embedded in a block of energy-absorbing plastic. In a smash, this material will soak up some of the impact, then slowly revert to its original shape.

Fact: Pedestrians are often hurt by bumper guards, headlight visors, even radiator ornaments.

Device: Besides the smooth front bumper, the safety car has smooth and rounded fenders, hood and grille. Headlights are recessed; ornaments are dispensed with.

Fact: Seats facing backward are safer—you are less likely to be tossed out of one in a sudden stop.

Device: One seat, backed up against the driver's, faces rearward. Cornell didn't know whether people would like to sit in it. So the idea was tried in a 1949 Studebaker. Once passengers got used to it, they liked it. Gave a club-car atmosphere, they said.

Fact: Many people complain that it is hard to tell whether today's cars are coming or going—especially at high speeds.

Device: The front and rear of the safety car look different. The front will have a horizontal motif on the grille. The rear will have a vertical design, maybe stripes.

Eight years ago, when Ed Dye and his associates began studying accidents, they ran into a difficulty at once.

"I could not," says Dye, "obtain a supply of human heads to learn why and how they cracked up in wrecks."

So before he made his plastic skulls, he experimented with eggs. "They simulate the human head," he explains. "Both consist of hard shells around fluids."

Dye placed eggs in boxes hung from the ceiling, then swung the boxes against the wall. He tried many different box designs. When he found one that kept the eggs from cracking no matter how hard it was smashed, he knew he had something.

What he had were snug-fitting pockets that held the eggs in place—which led to the car's safety belts and bucket seats. And padding—which pointed to the padding of the car.

He also had an idea—to package automobile passengers "the same as you would any other breakable object."

"Americans," Dye says, "daily climb into a car, drive many miles at dangerous speeds, use very few safety belts and a minimum of padding protection. This is just like shipping a small, delicate vase inside a large empty packing case."

The Cornell Safety Car, Dye explains, is nothing but a package designed to transport delicate objects safely—no matter how banged up the package gets. The delicate objects are you and your family. END

NEXT MONTH . . .
Two dream cars that you'll be able to buy: Mercury's Turnpike Cruiser and Cadillac's Eldorado Brougham.

IF you're that man, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period? Always provided that the rewards were good—a salary of $4,000 to $10,000 and up?

An accountant's duties are interesting, varied and of real worth to his employers. He has *standing!*

Do you feel that such things aren't for you? Well, don't be too sure. Very possibly they *can* be!

Why not, like so many before you, investigate LaSalle's modern Problem Method of training for an Accounting position?

Just suppose you were permitted to work in an accounting firm under the personal supervision of an expert accountant. Suppose, with his aid, you studied accounting principles and solved problems day by day—easy ones at first—then more difficult ones. If you could do this—and could turn to him for advice as the problems became complex — soon you'd master them all.

That's the training you follow in principle under the LaSalle Problem Method.

Over 4,200 Certified Public Accountants among LaSalle alumni

You cover accounting from Basic Accounting right through Accounting Systems and Income Tax Procedure. As you go along, you absorb the principles of General Accounting, Auditing and Basic Cost Accounting. Then you may choose Commercial Accounting, Industrial Accounting or Public Accounting and prepare for the C. P. A. examinations.

Your progress is as speedy as you care to make it—depending on your own eagerness to learn and the time you spend in study.

Will recognition come? The only answer, as you know, is that success *does* come to the man who is really *trained*. It's possible your employers will notice your improvement in a very few weeks or months. Indeed, many LaSalle graduates have paid for their training—with increased earnings—before they have completed it! For accountants, who are trained in organization and management, are the executives of the future.

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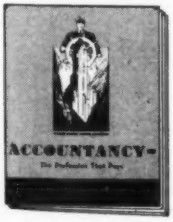
For your own good get all the facts about this completely new and modern accounting training. Write for Free book "Accountancy, The Profession That Pays," which will prove that Accounting offers brilliant futures to those who aren't afraid of serious home study, and will show the wide range of opportunities that exist today. No cost or obligation. If you want a position of higher income, greater prestige and professional standing . . . MAIL THE COUPON NOW!

Member, National Home Study Council



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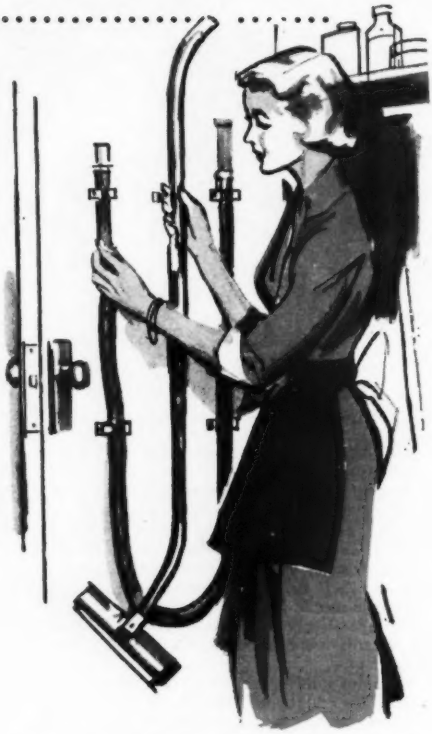
I want to be an accountant. Send me without obligation, Free book, "Accountancy, The Profession That Pays."

Name.....*Age*.....
Address.....
City, Zone & State.....

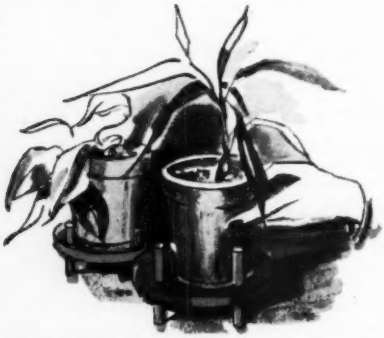
Keeping the Home Shipshape

OIL SEEPAGE from a fuel intake pipe killing off nearby shrubs? Sink a short length of soil pipe in the ground beneath it and line it with a coffee can to catch any oil that may drip.



SIX HUSKY TOOL CLIPS in a closet make a tidy job of storing a vacuum-cleaner wand and hose. Screw them to the door or to two boards fastened to the studs of the plaster wall.

SALVAGE THE DRAWERS of discarded chests, insert shelves and they'll display models in Junior's room, hold cookbooks in the kitchen or store stacks of towels in a bathroom.



FLOWERPOT TRIVETS can be made of wooden disks drilled to take three dowels that push through with a tight fit. They are useful for protecting window sills and table tops.

WHEN REDECORATING, a bottle of gold powder will do a lot to perk up the rooms. Mix up enough to refurbish worn brass-plated light fixtures or dingy imitation bronze ones.

INVENTORS

Learn how to protect your invention. The U. S. Patent Laws provide that any new and useful art, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof, may be patented if the act of invention is involved. Therefore, every inventor with a valuable invention should take advantage of the Patent Laws and proceed for patent protection in order to safeguard his rights.

A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

The Patent Laws were enacted for the benefit of the inventor to give him protection for the features of his invention which are patentable. These features must be properly and concisely set forth and claimed in a formal application for patent, in order to comply with the requirements of the Patent Laws. For that reason, unless the inventor is familiar with patent matters, he should engage a competent registered patent attorney or agent to represent him. We are registered to practice before the U. S. Patent Office and are prepared to serve you in the handling of your patent matters.

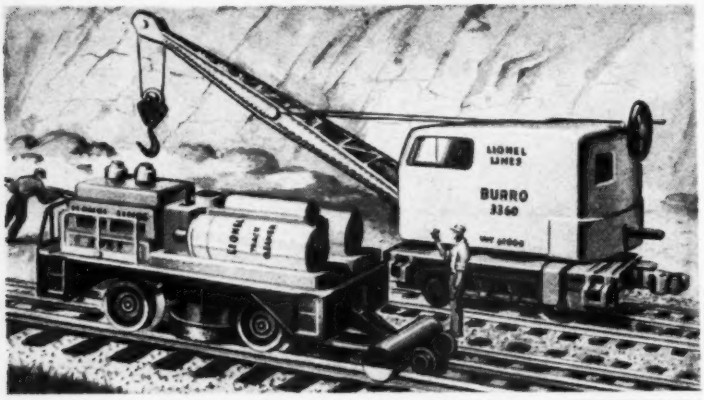
A specially prepared booklet entitled "Patent Guide for the Inventor", containing detailed information with respect to patent protection and procedure, together with a "Record of Invention" form will be promptly forwarded to you without obligation upon request.

CLARENCE A. O'BRIEN & HARVEY JACOBSON

Registered Patent Attorneys

62-M DISTRICT NATIONAL BUILDING
WASHINGTON 5, D. C.

Greatest things on rails . . .

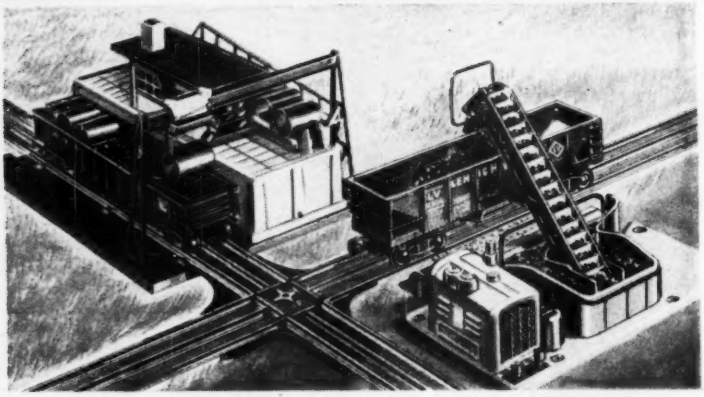


new operating burro crane

No. 3360. A real workhorse! Self-propelled, it can actually pull its own work cars! Rotating cab and working boom!

new track cleaning car

No. 3927. This car will actually wash and wipe track. When pulled by loco, motor-driven rotating brush cleans track with Lionel "Track-Clean". NO OTHER TRACK FLUID SHOULD BE USED.

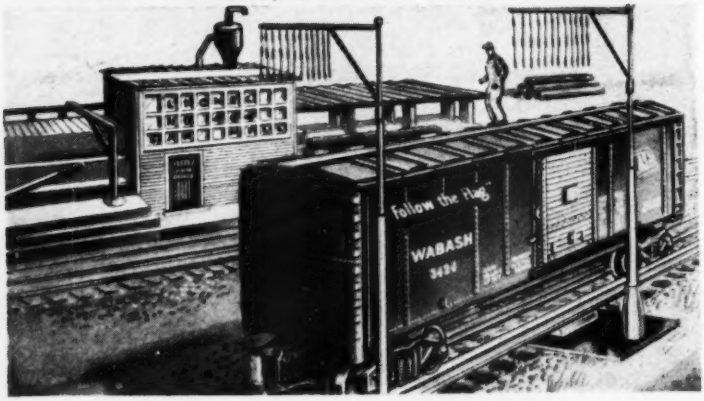


new operating culvert loader

No. 342. Puts a heavy-duty look in your yards. Travelling crane picks pipe sections off platform, loads them into gondola car. Workmen's shack houses remote control mechanism!

operating diesel-type coal conveyor

No. 397. Carries coal from bin and loads into car by remote control! Includes coal, controller, connecting wires! Car not included.



new operating lumber mill

No. 464. Conveyor belt picks up logs in bin via remote control, feeds 'em into mill, and delivers dressed lumber. Complete to sound of buzz saw.

new operating brakeman car

No. 3424. Low bridge warning signal pole makes man fall to avoid being hit. Second pole brings him upright! Includes car and warning signal poles.

and now LIONEL has 'em!

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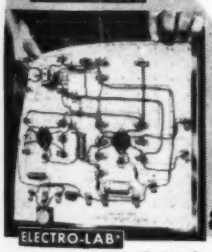

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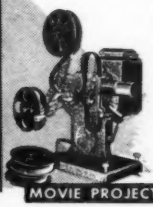

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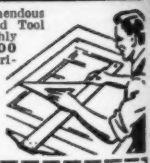

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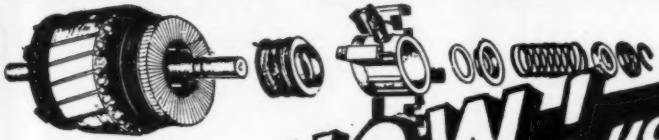

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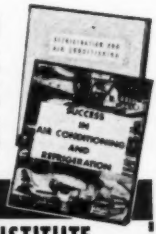

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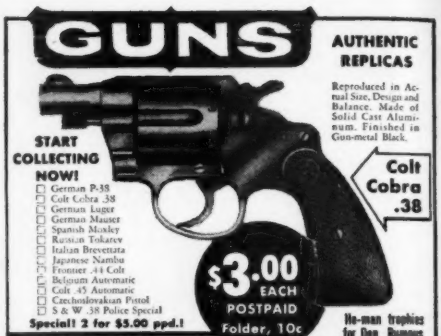

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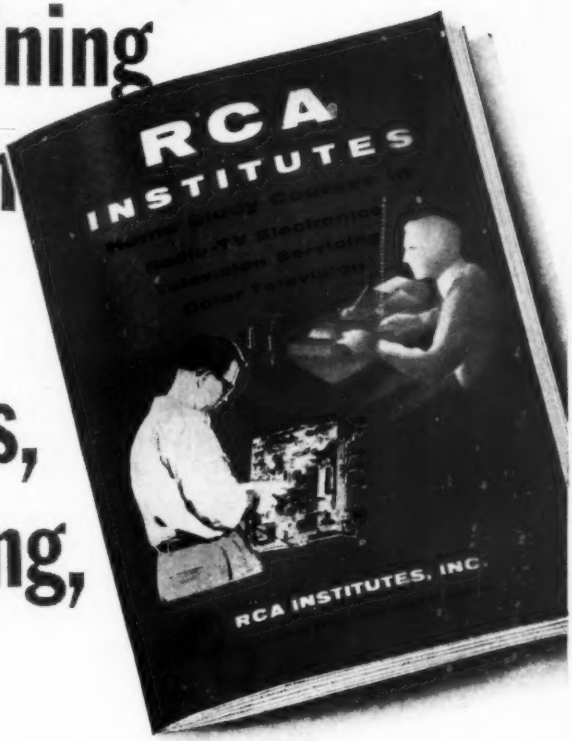

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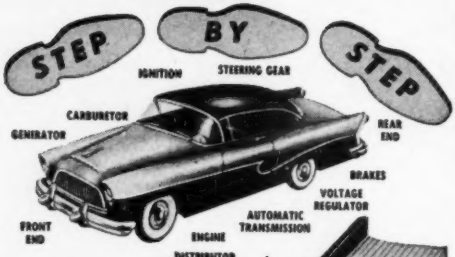

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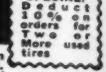

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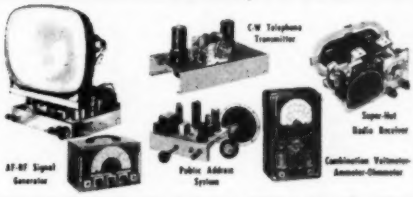

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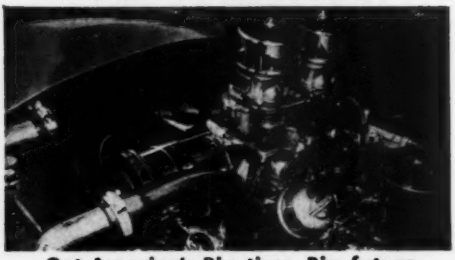

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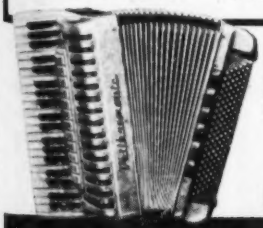

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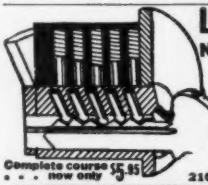

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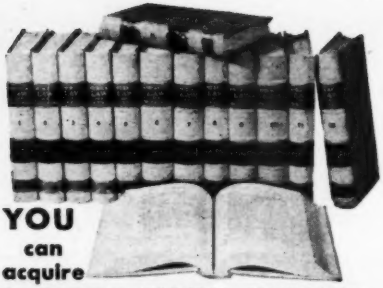

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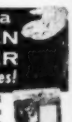

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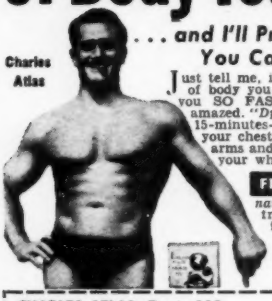

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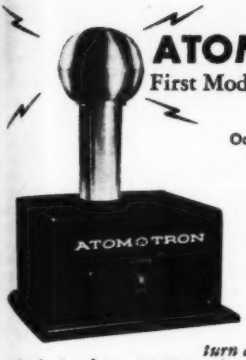

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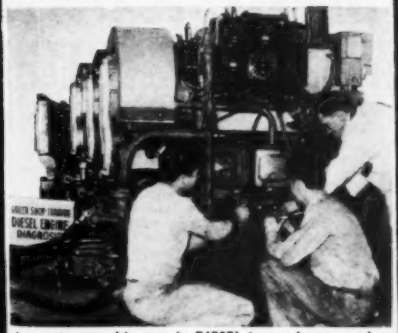

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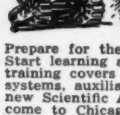

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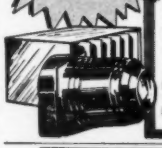

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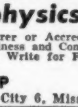

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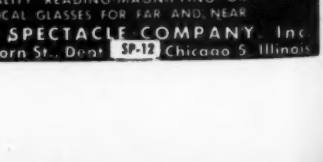

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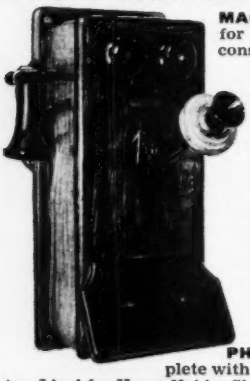

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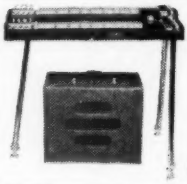

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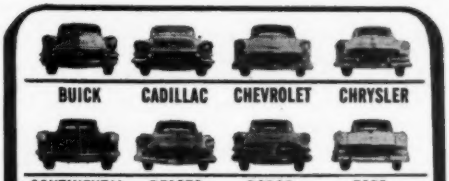

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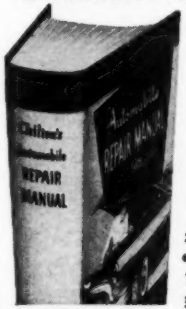

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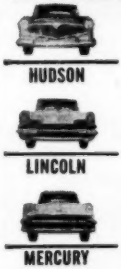

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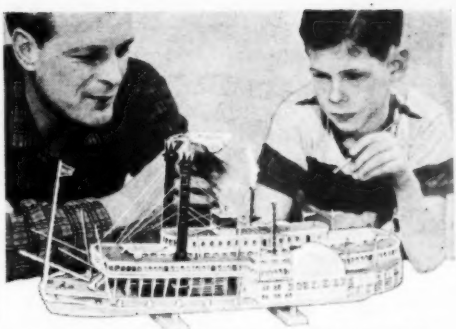

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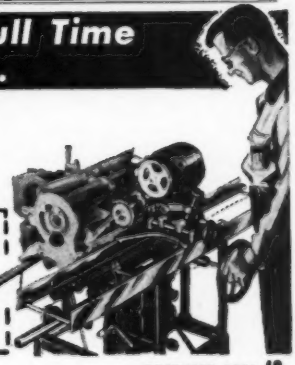

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USE THIS HANDY INDEX TO FIND WHAT YOU WANT

Advertising, Agencies for Advertisers . . . 53
Agents Wanted . . . 43
Antiques, Relics & Indian Goods . . . 29
Artists Supplies . . . 76
Authors Service . . . 52
Auto Supplies & Equipment . . . 2
Auto Trailers . . . 3
Automobiles & Midget Cars . . . 1
Aviation . . . 5

Batteries, Generators, Etc. . . . 6
Boats, Outboard Motors . . . 11
Body-Building Course . . Jiu Jitsu, Etc. . . . 12
Books & Magazines . . . 23
Build It Yourself . . . 66
Business Opportunities . . . 37
Business Service, Information, Name Lists . . . 50
Buy It Wholesale . . . 38A

Cameras, Photo Supplies . . . 34
Camping Equipment & Tents . . . 16
Cartooning, Sign Painting, Chalk Talks . . . 54
Chemistry & Physics . . . 41
Claim Investigators . . . 37A
Coins & Currency . . . 26
Color Photo Finishing . . . 32A
Contests . . . 46

Detectives . . . 47
Dogs, Birds, Hamsters & Pets . . . 17

Earthworms . . . 18
Educational & Instruction . . . 45
Electrical Supplies & Equipment . . . 7
Engines, Motors, Etc. . . . 10

Farms, Other Real Estate . . . 19
Field Glasses, Telescopes . . . 14
For Inventors . . . 60
For Sale Miscellaneous . . . 71
For the Home . . . 69
Formulas, Plans, Etc. . . . 39

Games & Entertainment . . . 24A
Geiger Counters, Treasure Finders . . . 77

Help Wanted . . . 42
High-grade Salesmen . . . 44
Hobbies, Collections . . . 31
Home Craftsman . . . 65
Hypnotism . . . 24

Inventions Wanted . . . 61

Language Outfits . . . 48

Machinery, Tool Supplies, Etc. . . . 9
Magic Tricks, Puzzles, Etc. . . . 25
Manufacturing . . . 63
Minerals & Precious Stones . . . 30
Miscellaneous . . . 79
Models, Model Supplies . . . 64
Moneymaking Opportunities . . . 38
Motion Pictures, Slides, Sound Equip. . . . 33
Motorcycles, Bicycles & Supplies . . . 4
Music, Song Writers & Records . . . 35

Of Interest To Women . . . 70
Old Gold, Jewelry, Watches . . . 67
Old Stamps Wanted . . . 27

Patent Attorneys . . . 59
Patents For Sale . . . 62
Personal . . . 80
Photo Finishing, Photocopies, Etc. . . . 32
Plastics . . . 40
Plays, Stories, Etc. . . . 49
Poultry & Supplies . . . 21
Printing, Multigraphing, Etc. . . . 57
Printing Outfits, Supplies . . . 58
Profitable Occupations . . . 22

Radio, TV, Supplies & Equipment . . . 36
Razor Blades, Shavers . . . 74
Rubber Stamps & Office Supplies . . . 56

Special Services . . . 51
Sporting Goods, Guns, Fishing Tackle, Etc. . . . 15
Stamp Collecting . . . 28

Tattooing Supplies . . . 75
Tobacco & Pipes . . . 68
Trees, Shrubs, Roots & Herbs . . . 20
Typewriters & Office Machines . . . 55

Wanted to Buy . . . 72
Watch Repairing . . . 78
Wearing Apparel . . . 73
Welding, Soldering . . . 8

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MAKE Extra Money. Cash commissions. Everybody buys easy-to-sell Advertising Book Matches. Union label. Big variety—Glamour Girls, Scenics, Hillbillies. Powerhouse selling kit Free. Steady repeat business. No experience necessary. Superior Match Company, Dept. PX-1256, 7528 S. Greenwood, Chicago 19.

MAKE Perfumes—Cleaners—Polishes—Cosmetics—Home—Sell Mailorder—International, 6347 Parnell, PS126, Chicago 21, Illinois.

STOP Looking—start earning. Unique, profitable business at home. No inventory, selling, or experience needed. Send $2.00 for complete instruction course and start cashing in. Gordon & Gordon, Dept. 416K, 333 N. Michigan, Chicago 1.

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$1400.00 OR more possible each month. New Service. Unlimited earnings. No merchandise. Keep present job, can operate confidentially. Men or Women. All for $1.00. Satisfaction or money back. McCoy, P.O. Box 8344, Jacksonville 11, Florida.

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YOUR Name Wanted by Publishers, mailers. We'll list your name sent to 1000 concerns, your name on our list one year 25c. Dixie Mailers, King, North Carolina.

SPECIALIZED Magazines—5,166 different, 1,137 Self-Help Books—all businesses, trades, professions, sports, hobbies, etc. Free List. Publications, 348 North Ritter, Indianapolis 19, Indiana.

$60 WEEKLY, spare time—easy! Home Venetian Blind Laundry. Free book. Burtt, 2434B, Wichita 13, Kansas.

FRANCHISES Make Profits! Become exclusive Distributor, Dealer, Agency Operator. Request information. National Franchise Reports, PS-528, 333 North Michigan, Chicago 1.

LIQUID Marble—Brushed! Sprayed! Mold novelties, tile! Particulars free. Marbleizing Service, Edwardsville, Illinois.

ABSOLUTELY Free! Complete mailorder instruction course. Cocard, Box 105-PS, Massapequa Park, New York.

LIQUID Rubber. Make flexible molds. Free Sample. Chaney, 1130 E. 16th St., Jacksonville 6, Fla.

MINK Raising information free. Complete. Lake Superior Mink Farm, Superior E E5, Wisconsin.

"MAILORDER Laws and Regulations," $1.00. Explains licenses, taxes, legal requirements. Tasker, 105 East Custis, Alexandria, Virginia.

INTERNATIONAL Import Index lists new exclusive imports. Free list. I.I.I., Box 636, Newark 1, N. J.

MAIL Catalogs Featuring Real Merchandise. Charles, Box 32-S, New York 63, New York.

50% PROFIT baking new greaseless doughnuts in Kitchen. Grocers buy daily. Free recipes. S. Ray, 3605 South 15th, Minneapolis 7, Minnesota.

NEW mail order method. Details. Chester, Box 865-A, Sea Cliff, New York.

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IMPORT your own products in small lots. Also, start profitable mail order business using International Dropshipment method. Capital unnecessary. Free details. Ga. Overseas Trading Co., Dept. D.3, 715 Persons Bldg., Macon, Georgia.

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REBUILD batteries; Make rubber stamps; Repair dolls. Catalog "60 ideas" free. Universal, Box 1076-B, Peoria, Illinois.

BULLETIN Listing choice Business Opportunities. "Dahle," Box 7-B2, Omaha 10, Nebraska.

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$12.00 DAILY Collecting Local Information. No Selling. Free Facts. Dorsitt, 2215 So. Walnut, Muncie, Indiana.

SAMPLES 10c. Profitable Mailing Business $1.00. Box 121, Newtonville 60, Massachusetts.

FREE Folio "$5.000-$45.000; Unlimited Vacations." No merchandise, equipment. Unknown! Work home—sparetime! Haylings—S-16, Carlsbad, Calif.

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WHOLESALE Prices. Free information. National Wholesale Service, Box 397, Buffalo 5, New York.

EARN $10,000 yearly raising Angora Rabbit Wool for us. Information, 25c coin. American Angora Company, Malta 1, Mont.

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"EVERYBODY Likes Candy." Make professionally home. (Our 45th Year.) Ragsdale Candies, East Orange, N. J.

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37A CLAIM INVESTIGATORS

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38 MONEYMAKING OPPORTUNITIES

START A Buying Service, buy wholesale thousands nationally advertised products. Make big profits selling at sizeable discounts. Postcard brings details. American Buyers', Hertel Station, Buffalo 16-O1, N. Y.

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MEN—Women! Start Money-Making Plastic Laminating Business at home in spare time. Material that costs 11c brings back $2.58. No canvassing or selling but mail orders bring in $20 a day. Write for full particulars Free. Rush name on postcard to Warner, Room 812, 1512 Jarvis, Chicago 26, Illinois.

DETECTIVES—Work home—Travel. Experience unnecessary. Detective Particulars free. Write, Wagoner, P-125 West 86th, New York 24.

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MEN and women wanted to start home business in spare time with little table-top rubber stamp machine. Easy to earn up to $9.80 an hour without previous experience. Full particulars Free by mail. Send postcard to Roberts, 1512 Jarvis, Room 812, Chicago 26, Ill.

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UNLIMITED opportunities. Dozens of formulas. Make at home, sell everywhere. Send $2.00. Winter, 100 East Oak, Perry, Florida.

$60 WEEKLY, spare time—easy! Home Venetian Blind Laundry. Free book. Burtt, 2434B, Wichita 13, Kansas.

REPAIR Electric Irons. Complete course $3.98. Oriole, 1101 W. Baltimore, Balto. 23, Maryland.

MONEY making Mail Order opportunity, build to Big Income. Details. Arthur King Isaacs, 2908 North Sycamore Street, Arlington, Virginia.

TAKE money-worry out of your future. $1.00 investment brings you full details on unique, money-making plan. Easy, practical, highly profitable. Send to The Counting House, Box 43, Hubbard Woods, Illinois.

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$10,000 WEEKLY. Newspaper contests. Write. Contests, 166-B Catherine, Red Bank, New Jersey.

INCREASE Your Income! Many profitable opportunities! Write: George E. Talbot, Norwood, Massachusetts.

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MAGIC Liquid Shoe Soles, Heels. Apply with Putty Knife in Five Minutes. Stronger Than Steel, Resists Water, Oil, Heat. Sticks To Anything. Inquire: Box 112, Villa Grove, Colorado.

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N.Y. Opportunities! Employment Classifieds Airmailed $1.00. Sunday (over 10,000 jobs—male or female)—$1.50. Century, 210-S Fifth Avenue, New York City 10.

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44 HIGH-GRADE SALESMEN

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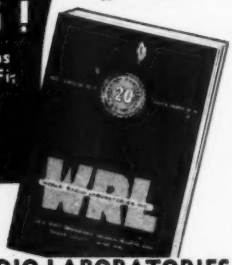

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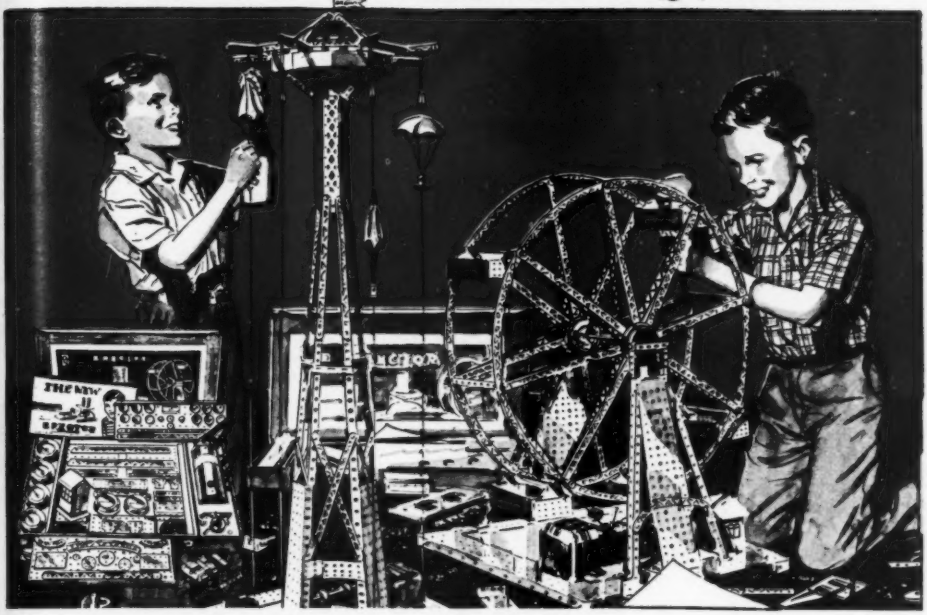

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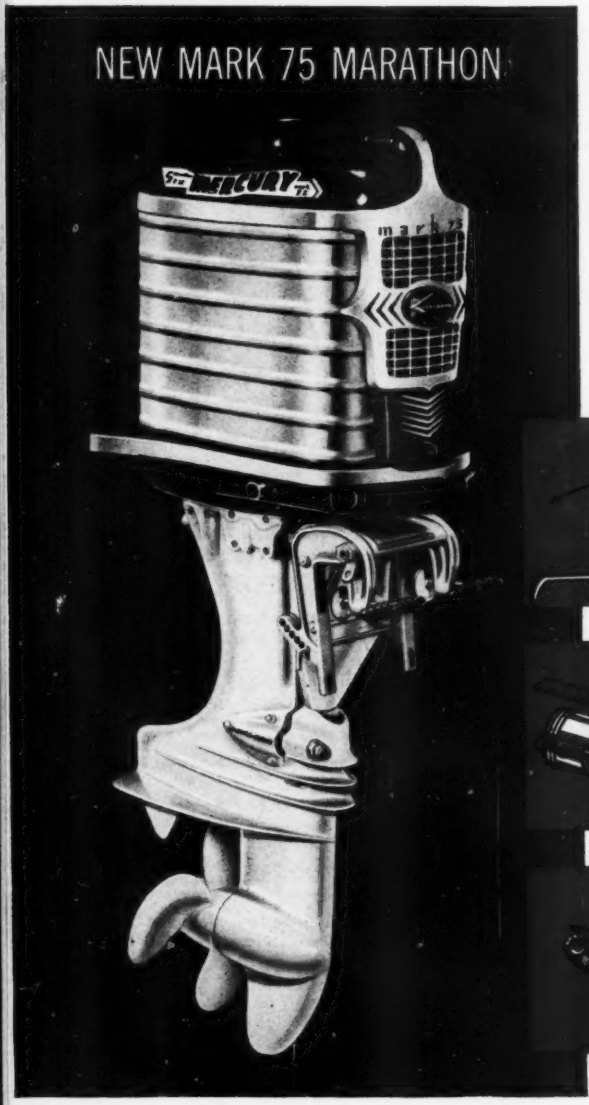

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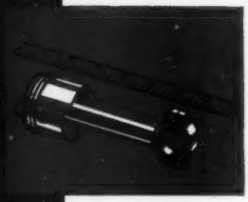

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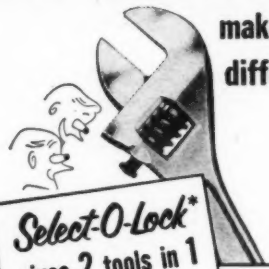

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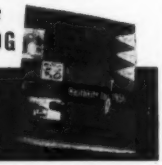

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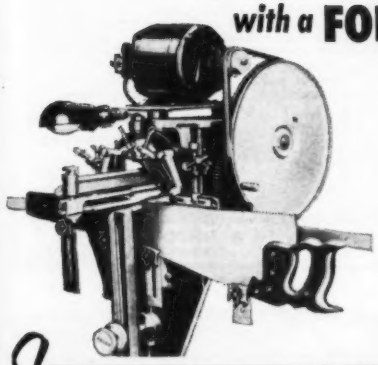

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It's no trick to take care of the saw filing for your neighborhood hardware or lumber dealer — plus looking after the saws for farmers, townspeople, manual training departments and factories. The Foley files all hand saws, also band and cross-cut circular saws. It's a repeat cash business, no canvassing, no eyestrain and no experience needed.

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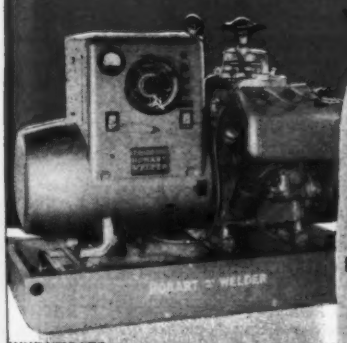

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● Amazing buy for men or boys. Make 100s fascinating experiments. Keep up with science. Have your own home laboratory. Build fire and burglar alarms, make real Geiger uranium detector, caves dropping units, fish shocker, etc.
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● Load capacity 1000-lbs. on 6-v, 2000-lbs. on 12-v. Holds up to 40' cable. Cuts truck loading time in two. Farmers use for wagon dump, machine hoist, on jeeps or cars to pull out of mud, etc. Govt. cost $280 SALE **$46.71** FOB

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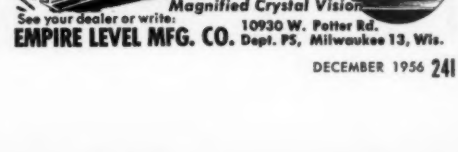

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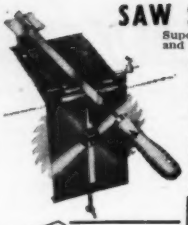

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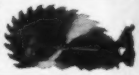

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Buy power for pennies. Ideal for welding, battery charging, emergency lights for cabins, camps, trailers, aircraft or wherever power needed. Easy rope pull starting. Fully equipped, ready to start. 2000 W. 32 V. 5 HP. Complete, nothing else to buy. Like new, tested. Shock mounted. De Luxe type. Net wt. 115 lbs., gross wt. cased 200 lbs. Approx. GOVT. COST $700. While they last— $39.95.

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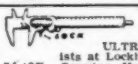

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For diesels, ships, farm machinery, trucks, bridges, oil fields, all heavy equipment. Terrific leverage. 4' Lowell, safety steel, sockets for 2 3/8", 2 9/16" & 3 1/8" hexagon nuts. Navy surplus. Approx. GOVT. COST $215 a set. Wt. 50 lbs. NEW! Now **$10.95** per set.

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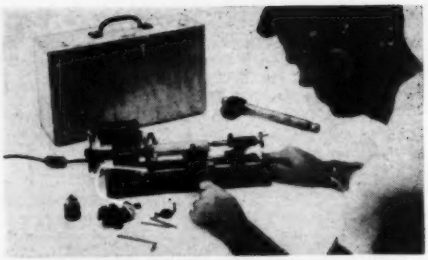

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CRAFTSMEN, MODEL BUILDERS, HOBBYISTS AND INVENTORS all over the world are choosing this unique and extremely versatile electric tool for machining small parts from steel, brass, wood, aluminum and plastics. Highly acclaimed because of its precision results, UNIMAT offers these serious craftsmen many other worthwhile advantages.

UNIMAT BASIC UNIT (shown) INCLUDES: 1–a Precision Lathe and all accessories necessary to convert it quickly and easily into a 2–Drill Press; 3–Hand Drill; 4–Polishing Grinding Machine; 5–Tool Grinding Machine; 6–Milling Machine. With the Basic Unit you also get these 13 accessories Free: AC/DC Power Motor, with reduction pulleys (11 speeds–375 R.P.M to 9200 R.P.M.), self-centering universal three-jaw "Cushman" lathe chuck with reversible jaws (abt 2½" Dia.), ½" Drill Chuck, Pivoting Tool Holder, Grindstone Holder, Lathe Dog, Face Plate, 2 centers, Allen Wrench, Easy-to-follow instruction manual, all packed in sturdy wood veneer carrying case!

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UNIMAT BASIC UNIT COSTS ONLY $99.50 and can be obtained on a budget plan for as little as $49.50 down, and $10 a month for 5 months. There's no charge for this service. It is shipped prepaid East of the Mississippi. West thereof, a slight charge is necessary. Additional literature is also available for only 10¢ to cover mailing costs. Look into this amazing precision tool today. It will prove worth your while.

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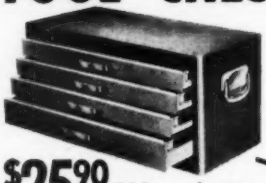

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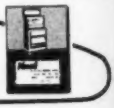

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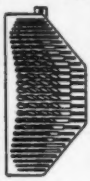

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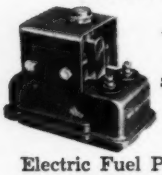

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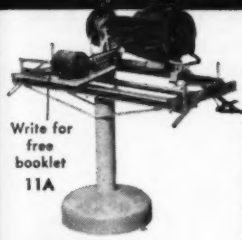

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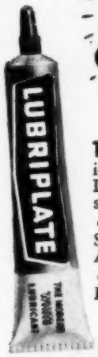

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THROWS A BEAM TO 1000 FT.

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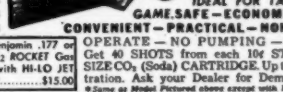

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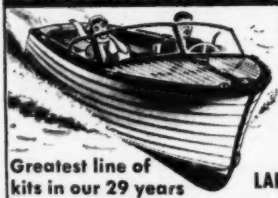

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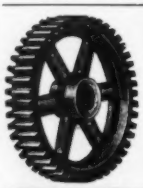

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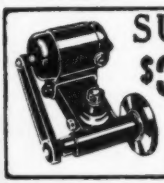

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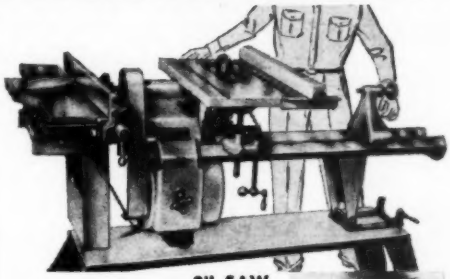

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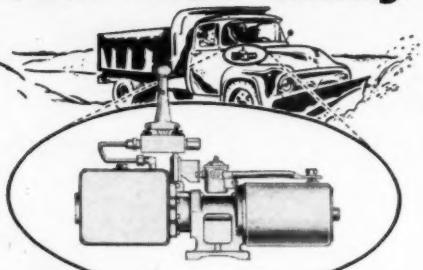

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(signed) Godfrey Hammond, Publisher

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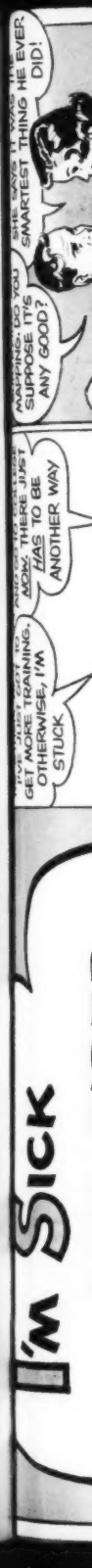

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1.

EVERYTHING COMES TO HIM WHO WAITS? THAT'S A LAUGH. I WAITED FOR THE BREAK. WAITED 'TIL I WAS SICK OF IT. HOW LONG CAN A GUY WITH A WIFE AND KIDS GO ON DREAMING?

2. MY WIFE AND I THOUGHT ABOUT IT, TALKED ABOUT IT, WORRIED ABOUT IT. WE WERE STUMPED. WE THOUGHT WE HIT A DEAD END

ONE DAY—MY LUCKY DAY—I TOOK A CLOSE LOOK AT THAT FAMOUS I.C.S. COUPON. I'D SEEN IT BEFORE A THOUSAND TIMES. BUT THIS TIME I REALLY *LOOKED*

I.C.S. IS THE OLDEST AND LARGEST CORRESPONDENCE SCHOOL IN THE WORLD. 256 PERSONALIZED-INSTRUCTION DIPLOMA COURSES

THIS IS THE TRUE LIFE STORY JOHN W. HARVIN, JR. OF DAYTONA, FLORIDA. FROM OUR I.C.S. SUCCESS FILES

4. THAT SETTLED IT! I DECIDED TO FIND OUT WHAT I.C.S. WAS ALL ABOUT. AFTER ALL, WHAT DID I HAVE TO LOSE?

5. WHEN I SAW THE THREE FREE BOOKS, I KNEW I'D FOUND THE ANSWER. I ENROLLED —AND I WAS ON MY WAY!

6. JOHN HARVIN'S SUCCESS STORY CAN COME TRUE FOR YOU, TOO. HERE'S THE FAMOUS I.C.S. COUPON. LOOK IT OVER. CLIP IT. *MAIL IT NOW!*

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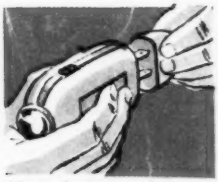

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